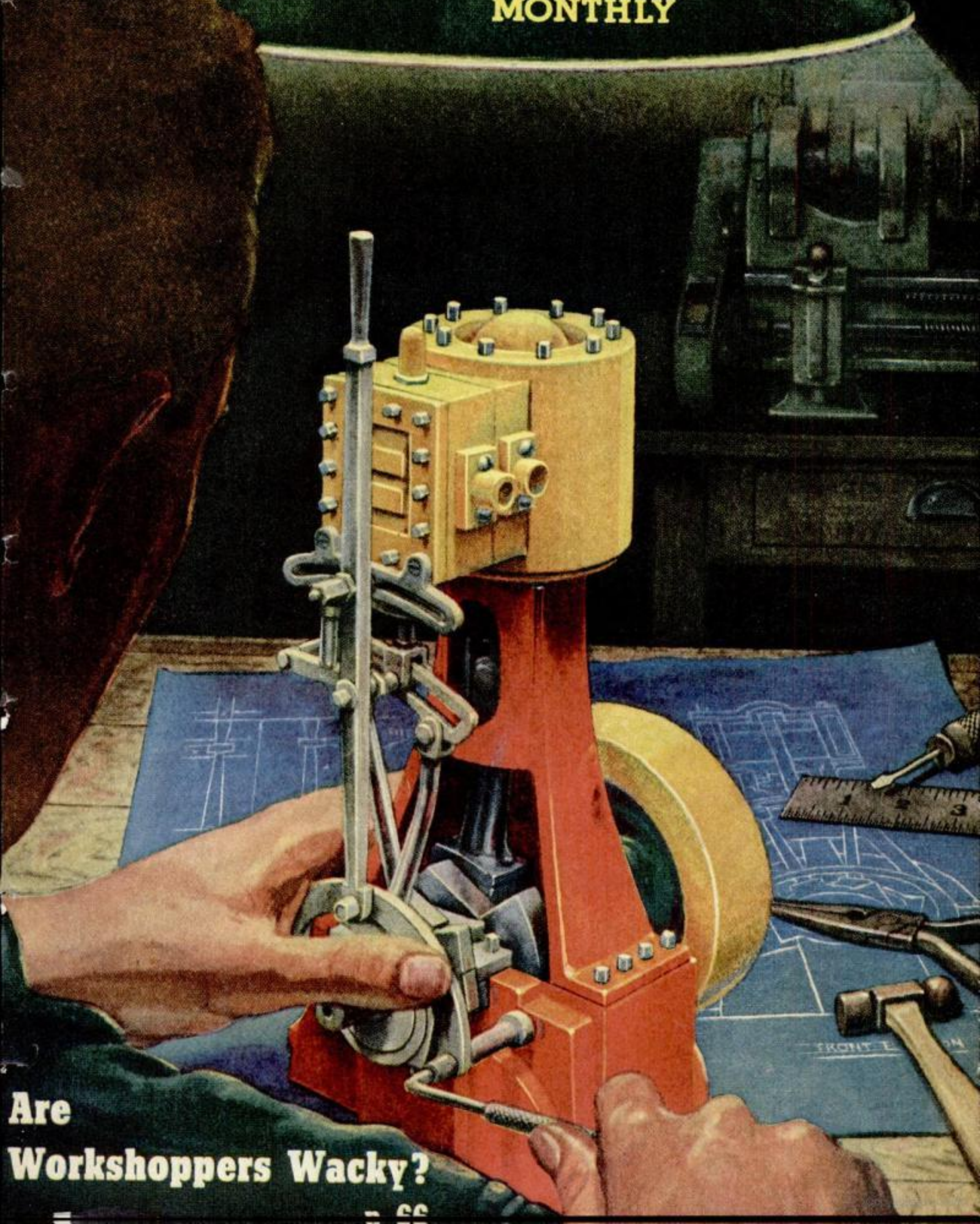


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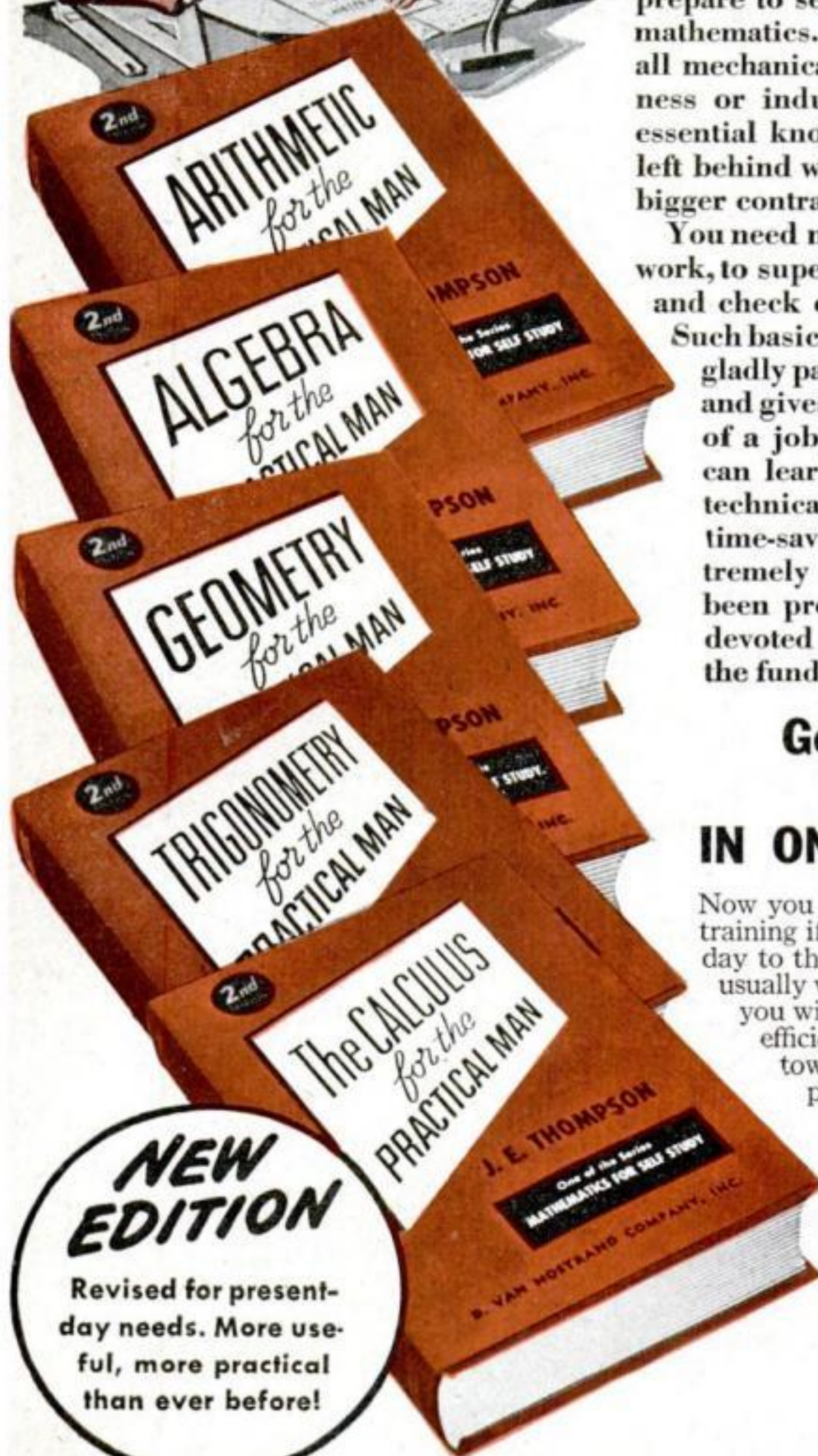
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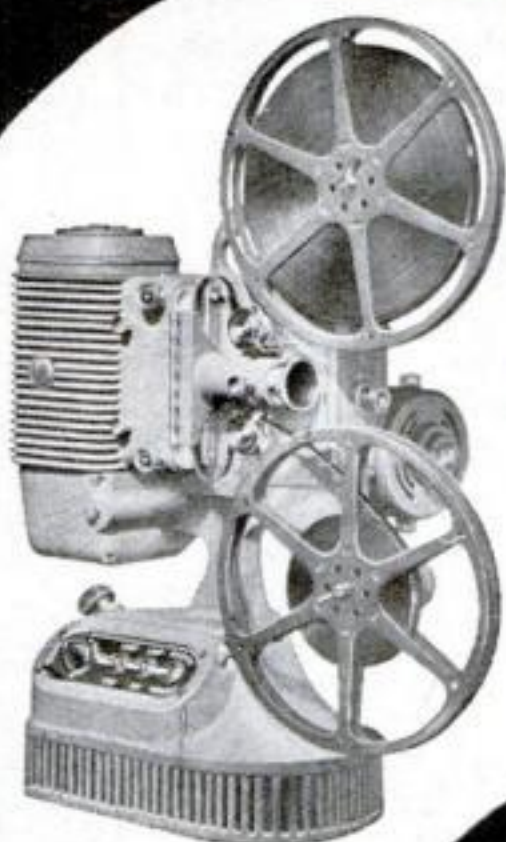
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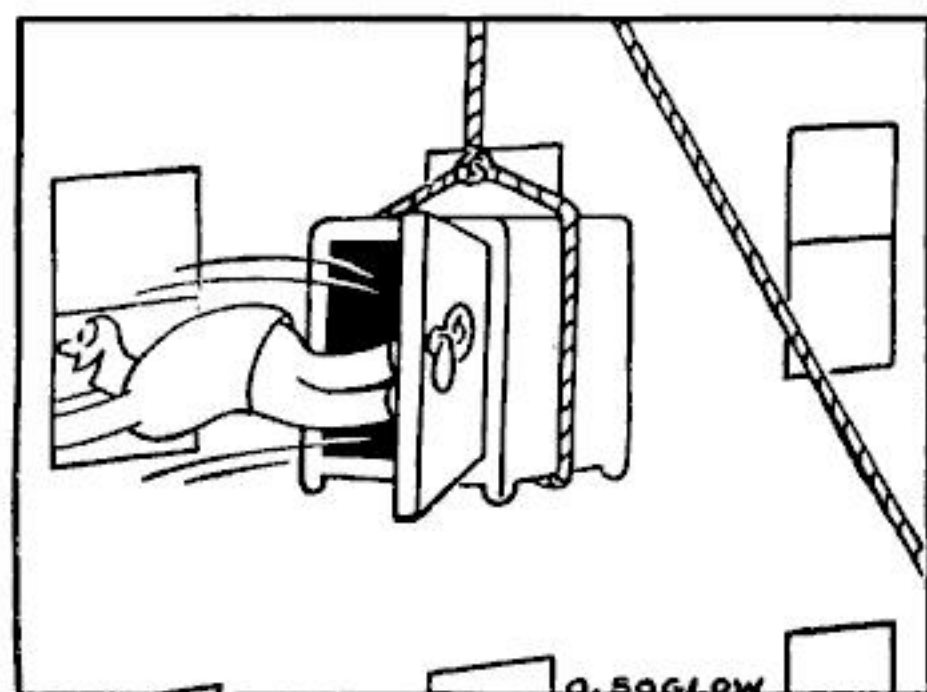
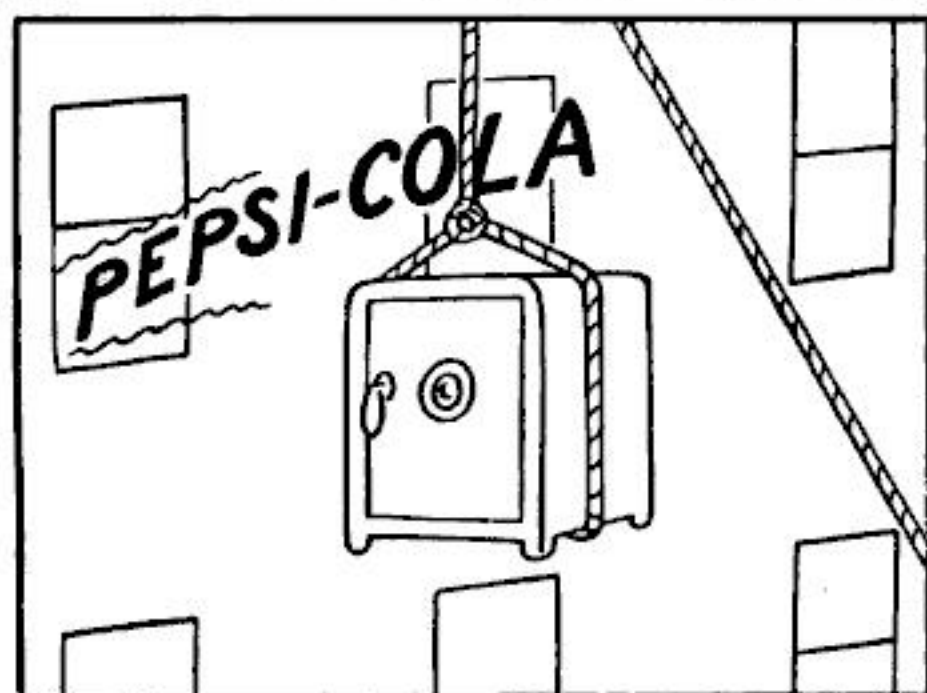
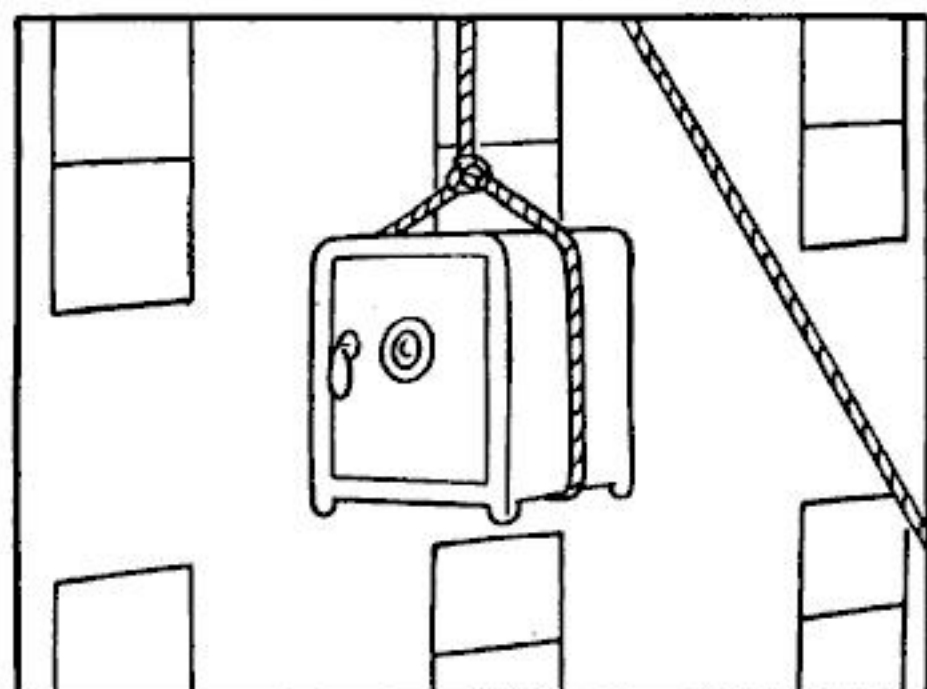
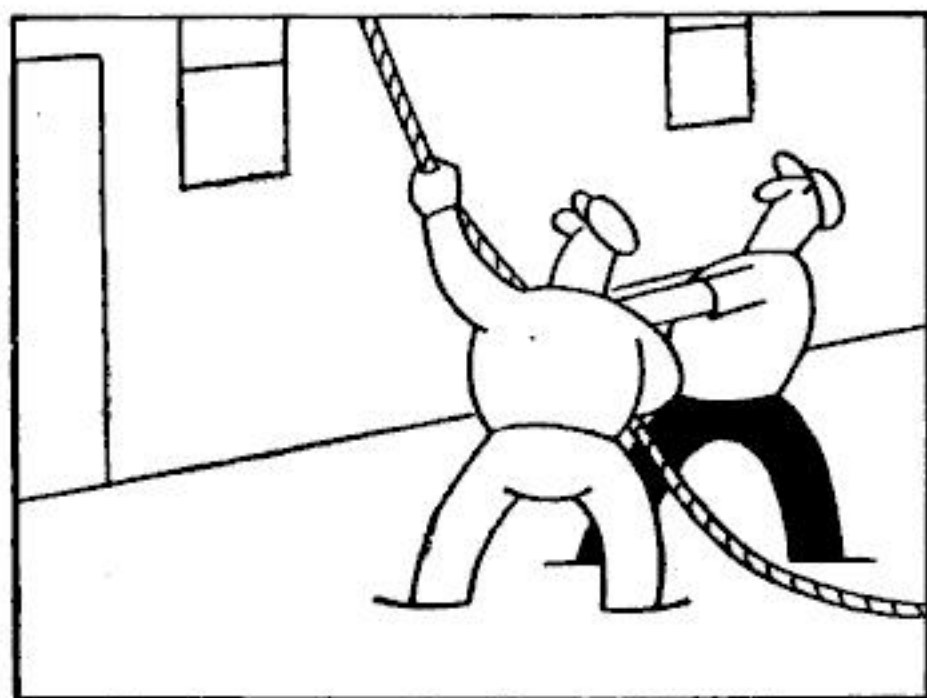
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Should Scientists Take An Oath?

(A Statement by the Editor of Popular Science Monthly)

FRESH-SHINGLED Doctors of Medicine commonly take the Oath of Hippocrates and thus subscribe to a code of medical ethics. There has been proposed a similar oath for scientists, whereby they would swear by whatever gods or immutable truths they hold sacred to work only for the welfare of mankind, and to avoid that scientific sin which is secrecy—military or national.

The idea has its merits. The orderly curiosity that is science is as international as the wind, and your true scientist is in the business of secret-smashing. It has also been suggested that an international priesthood of science might prevent war by some kind of scientific sit-down strike.

But the scientists are also discovering that they are people, too. And it is the scientist as a human being and a citizen who is shocked by his responsibility in the perversion of science to destruction. Furthermore, no scientists' oath to work only for the welfare of

humanity could mean much for the simple reason that no one could foretell what any discovery would entail. A research into the cure of cancer, for instance, might ultimately reveal enough knowledge of the cause to make the dread disease another weapon.

If the scientist is to be the saviour of frightened, ignorant humanity, no negative oath will help. Our trouble now is that the so-called social sciences have not caught up with nuclear physics. We need to know why humans behave like animals; what makes people stupid, greedy, bloodthirsty; how to stop a war, or start a crusade for decent brotherhood.

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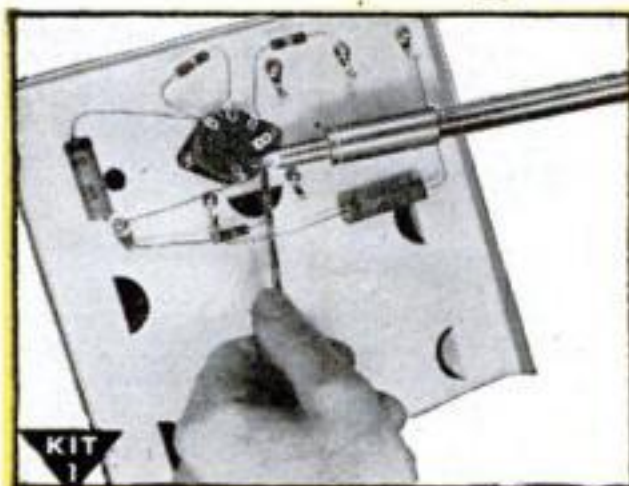
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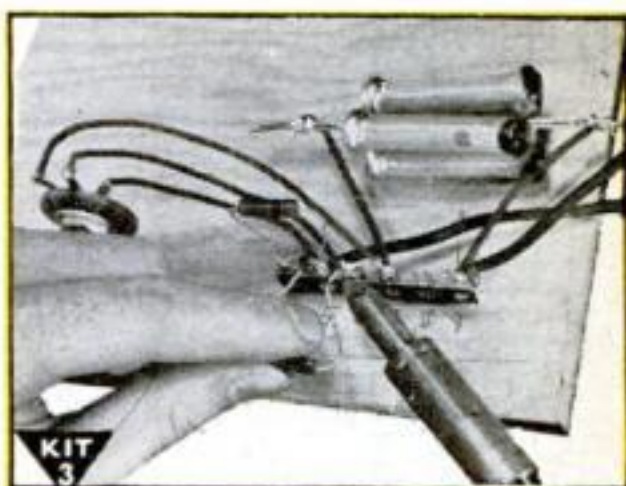
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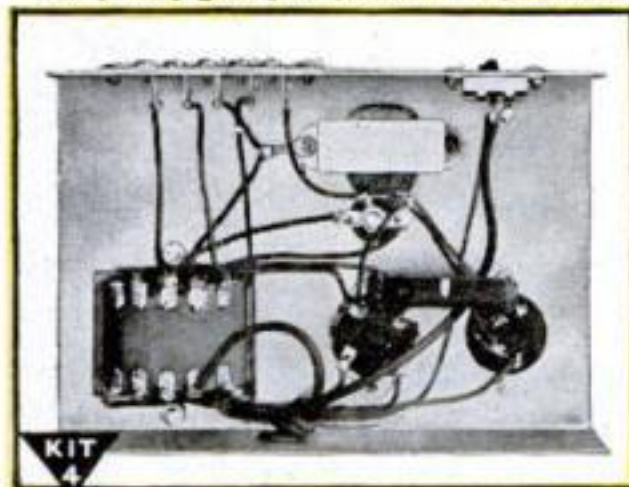
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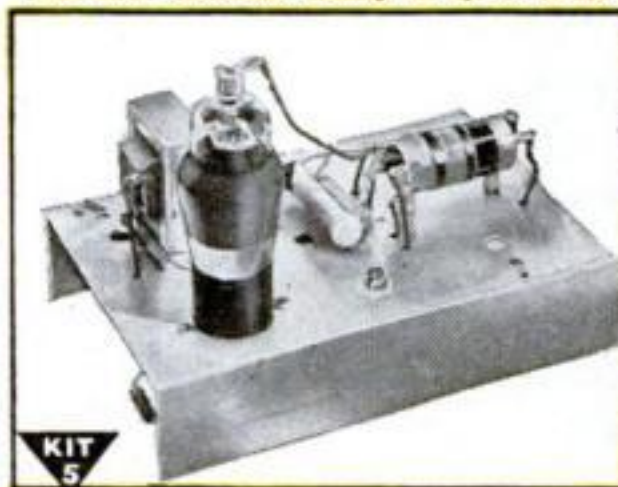
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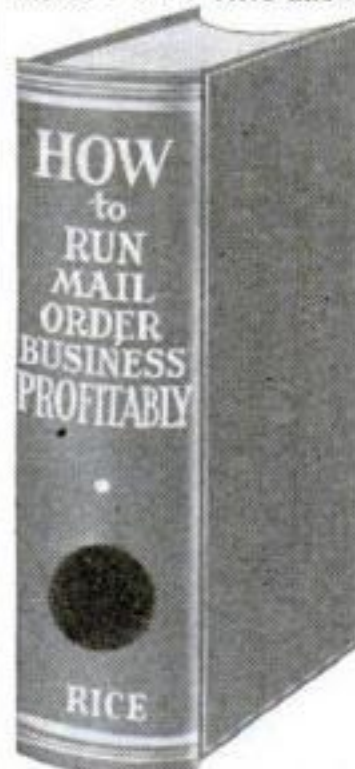
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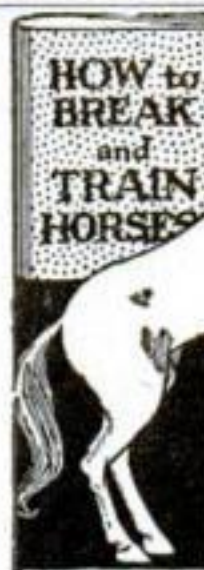
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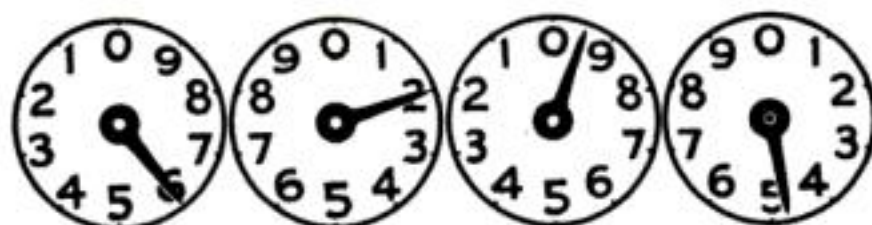
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LETTERS

Tricky Meters

Sir:

In your September article on how to read gas and electric meters—my daily job—I noticed that the examples did not include the thing that makes meter reading hard and catchy. Here is an example to show what I mean:



Many people would read it as 6294, but they would be wrong. It really reads 6194, because the second dial from the right has not reached the 0; so the third dial from the right is not a 2, as it appears, but is rightfully a 1. . . . I read an average of 160 meters a day, and I wager I'll find at least 20 of the tricky type. A hand can become loose at the pivot, causing it to slip ahead coming down from the 0 and fall behind on its way up after passing the 5.

HENRY HARRISON, JR.

Pawtucket, R. I.

Sir:

. . . The article states that the gas meters register 5,883,000 cubic feet for the four-dial meter and 328,000 for the three-dial meter. This is incorrect. The four-dial meter registers 588,300 cubic feet; the three-dial meter, 32,800 cubic feet. Incidentally, I read over 100,000 meters a year.

HERBERT ZIELKE

Bronx, N. Y.

What with slipping hands and erroneous extra zeros, meter reading is tricky. PSM's thanks to two experts.

More Waste at Work

Sir:

Readers of your interesting article, "Putting Waste to Work in the Air," (PSM, July '46, p. 112) may be interested in another

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One of the reasons why we were able to enclose the forward engine of the Fireball so completely was this augmented cooling by jet pump action. We also used jet thrust from the exhaust to get added speed. It sounds almost like the story of using every part of a pig in the slaughterhouse.

WILLIAM P. BROTHERTON

Technical Editor
Ryan Aeronautical Company
San Diego, Calif.

No Grading Ring

Sir:

In your October issue, an illustrated write-up regarding our ball-grading machine . . . referred to "grading rings" whereby the steel balls are guided to numbered chutes. . . . The picture to which you referred represents an exaggerated cross-section of a ball bearing, showing the result of using one oversized ball in a bearing assembly.

WHIT HILLYER

Bell & Howell Company
Chicago, Ill.

PSM stands corrected.

Light on Filters

Sir:

. . . What prompted me to write this letter was Kenneth S. Johnson's article, "Filters . . . Magic Eyes of Photography," in your September 1946 issue. I have read quite a bit on this matter in other books and have talked to salesmen about filters. Still, my mind wasn't too clear on this theory—until Mr. Johnson's article put the light on in my mind. His method of explaining is very clear and concise. . . .

EDWARD GRAY

Jersey City, N. J.

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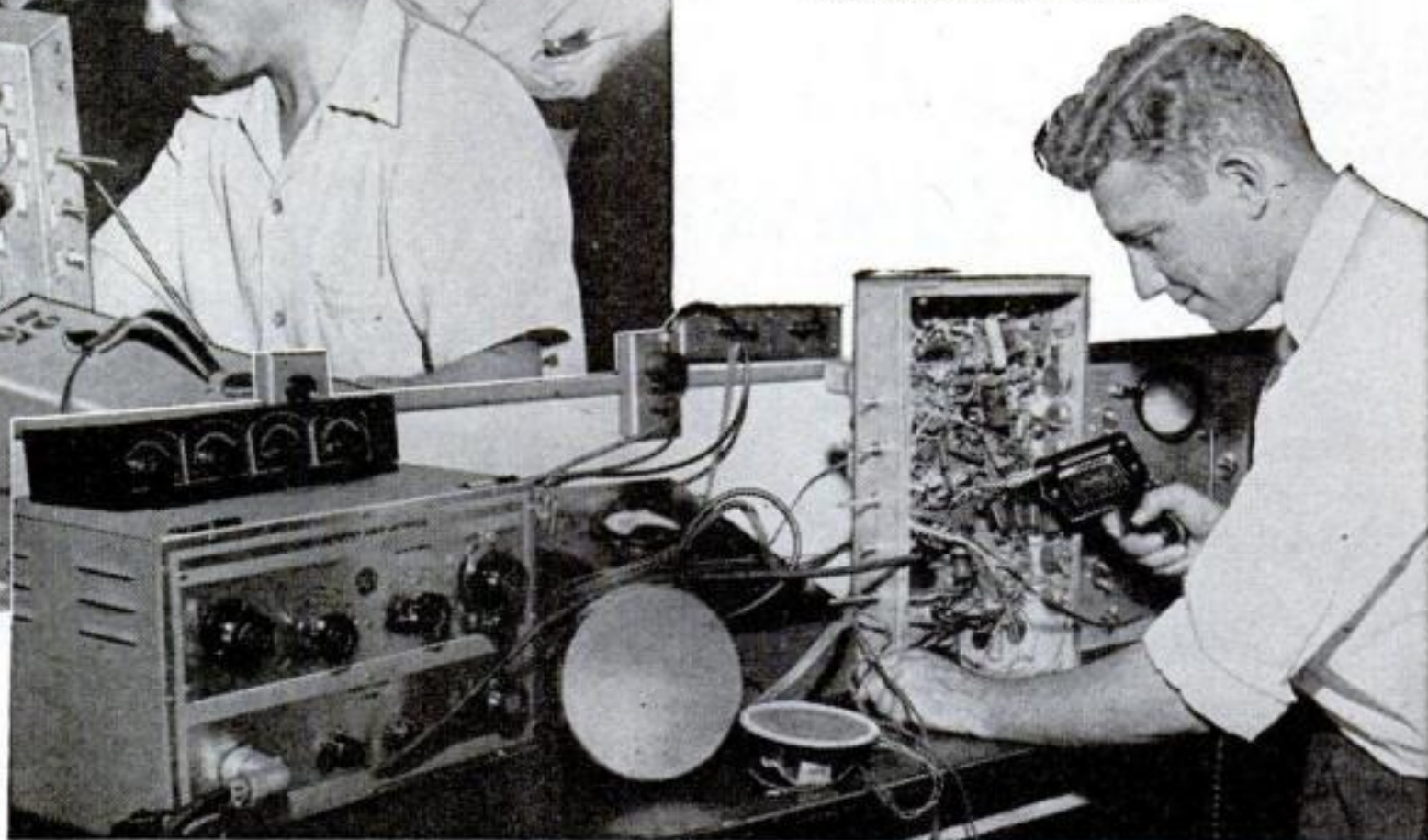
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Expert Television Technician, Bob Cohen, using \$625.00 RCA Sweep Generator to check television set for engineering inaccuracies. It is expected that television test equipment will be reduced in cost as the television industry gets into its stride.

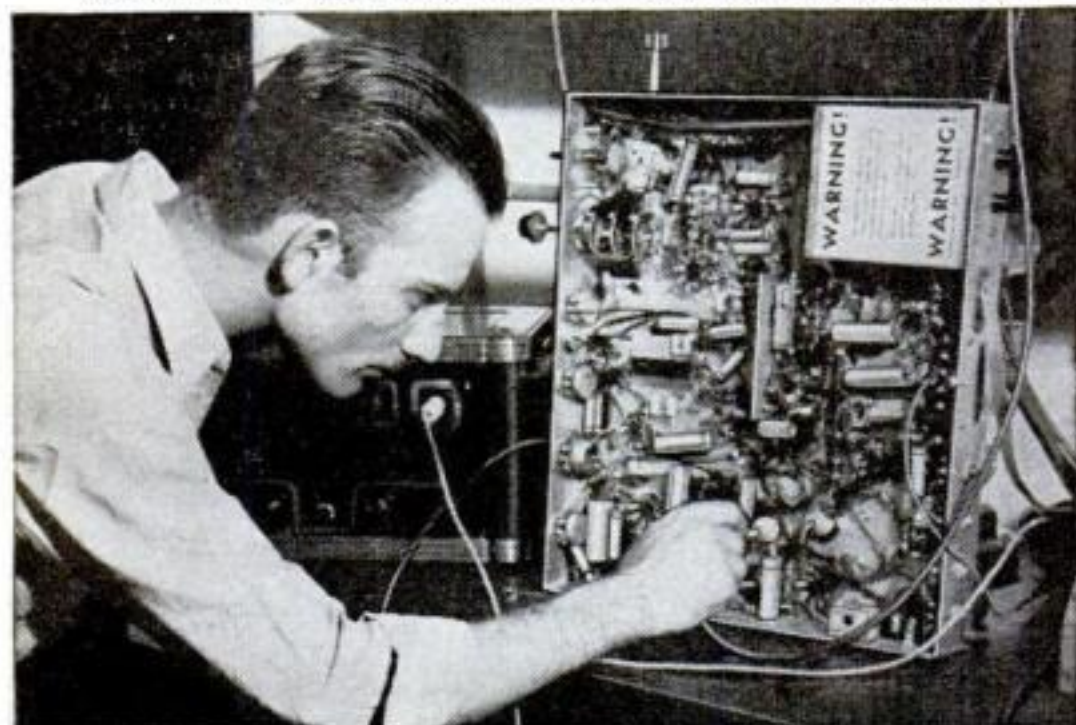
Individual instruction is necessary in teaching television. Here an instructor helps a student. Each student must build 7 radio sets before he is allowed to start on a television set.



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MANY veteran students are now attending N.Y.T.I. of N.J. under the generous provisions of the G.I. Bill of Rights, which allows any approved school of the veteran's choice to charge the Veterans Administration up to \$500 a school year against the educational expenses of qualified veteran students. Full-time students, with dependents, are also paid a sub-

Student Walter E. Stevens, making engineering checks with \$395.00 United States Television Sweep Generator. The school is lavishly equipped with the most advanced test equipment.

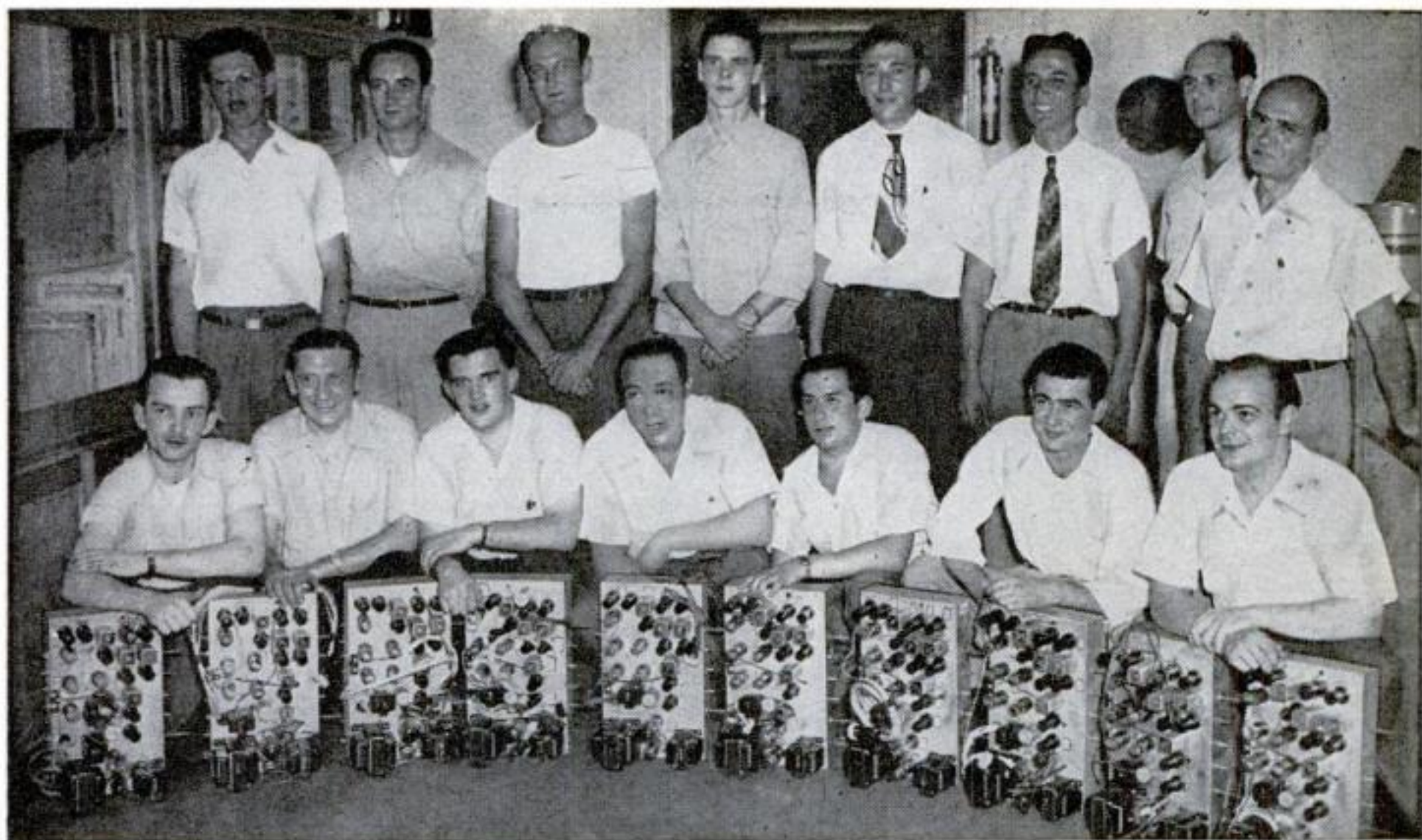


sistence allowance of \$90 monthly by the VA, and those without dependents, \$65. Many students hold part-time jobs, thus augmenting their monthly payments. However, you do not have to be a veteran to be accepted as a student.

A considerable number of out-of-state students attend the school because of its excellent, practical type of radio and television courses, so difficult to get anywhere else in the world today. Living quarters are obtainable by single students, but married students report considerable difficulty in finding quarters for their families.

No high-school diplomas are required. Every student must have at least a grammar-school education; however. And the school requires that a student be earnest, sincere and technically inclined. Students without proper mathematical backgrounds are taught the radio and television mathematics they need.

You probably have been wondering what N.Y.T.I. of N.J. means. It stands for the New York Technical Institute of



An Advanced Class in Television at N.Y.T.I. of N.J., famous television school, and the 17-tube television sets they built. Students at this school have been building television sets as part of their courses since 1939, when television programs were first broadcast regularly. School officials

found that this practical method of instruction is productive of very satisfactory results. Each student may build a set and keep it to use in his own home laboratory, if he chooses to. The school is located in the heart of the radio, television, electronics industry.

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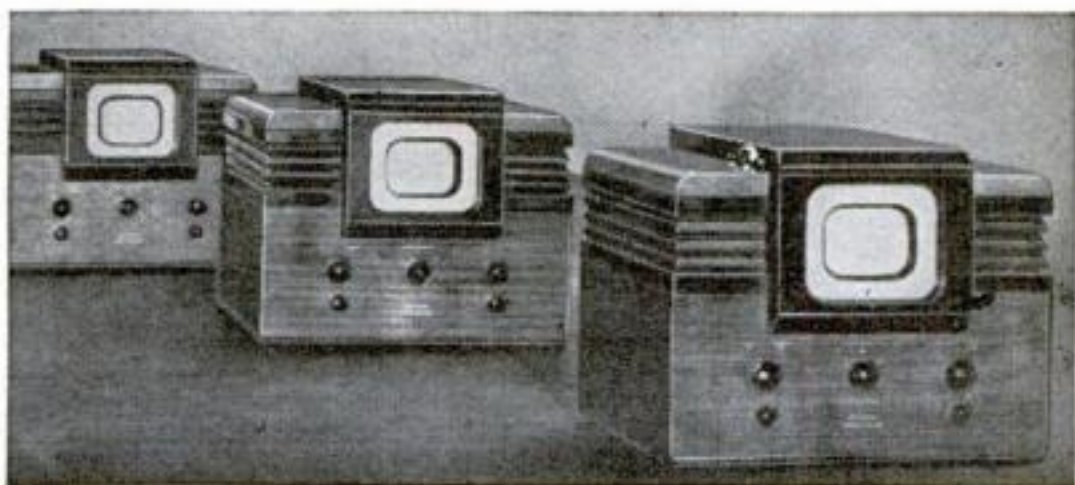
New Jersey, a resident school located in Newark, N. J., just across the river from New York City (Only 20 minutes from Broadway by subway or train). The school is located in the heart of America's great radio and electronics industry. Such leading television, radio and electronics manufacturers as Western Electric, Du Mont, Federal and Edison are nearby. Newark also is near Radio Stations WJZ, WEA, WABC and WOR; each a leader in broadcasts going on networks all over the country. This means that the school offers numerous advantages, as it is in touch with most recent developments in radio and television. This also means that qualified radio and television engineers are available to the school for teaching purposes.

During the war N.Y.T.I. of N.J. was approved for the training of Signal Corps personnel by the Army. When the war ended the enrollment increased because of the influx of veterans desirous of getting practical television training. At the present time, there are

120 openings for new students for the several classes beginning in October & November 1946.

The school issues a special Bulletin, Numbered 312, which illustrates and describes its facilities and equipment and shows students using its varied laboratory equipment. Bulletin 312 also describes classes that may be attended, housing conditions, costs, hours, etc. To get complete information write for Bulletin 312 (for which no charge is made) to the New York Technical Institute of New Jersey, 158 Market Street, Newark, New Jersey.

A line of RCA television receivers used for comparative test purposes at N.Y.T.I. of N.J.



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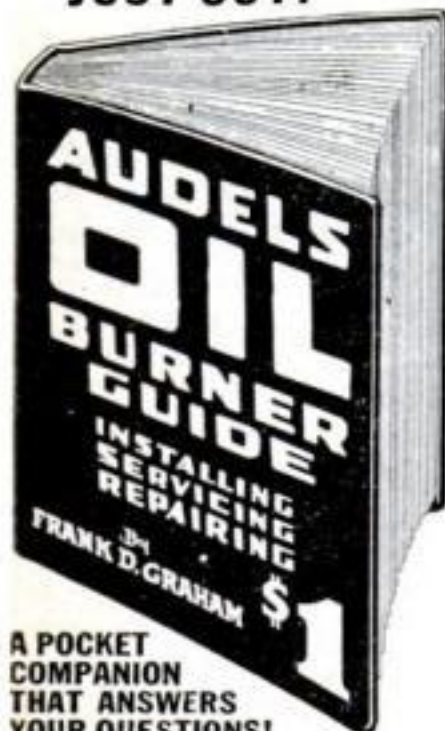
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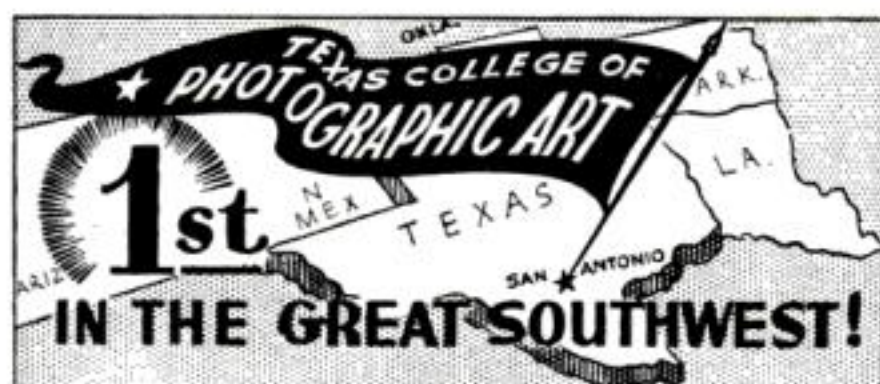
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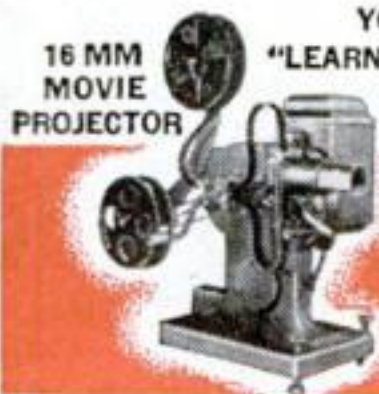
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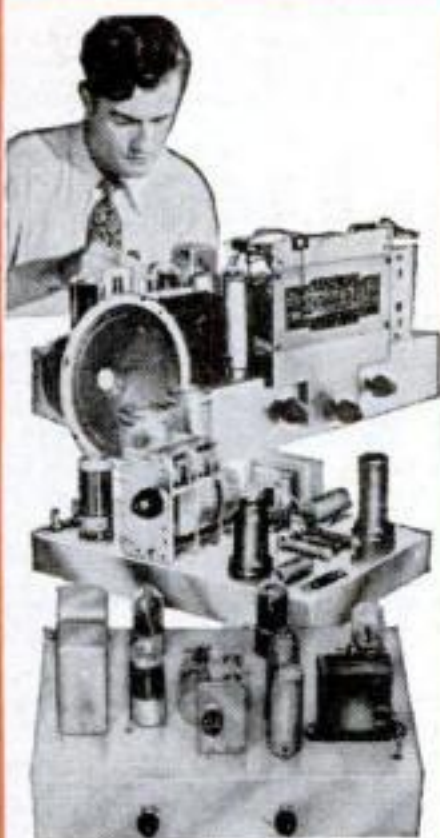


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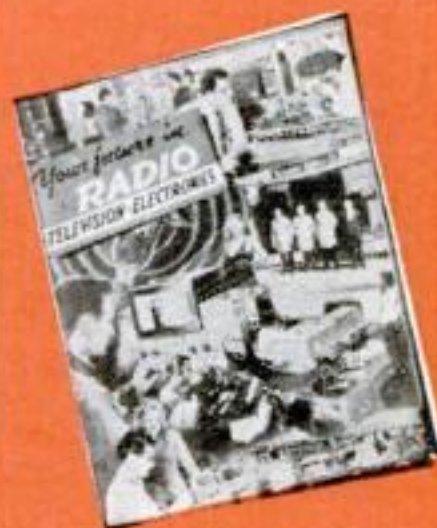
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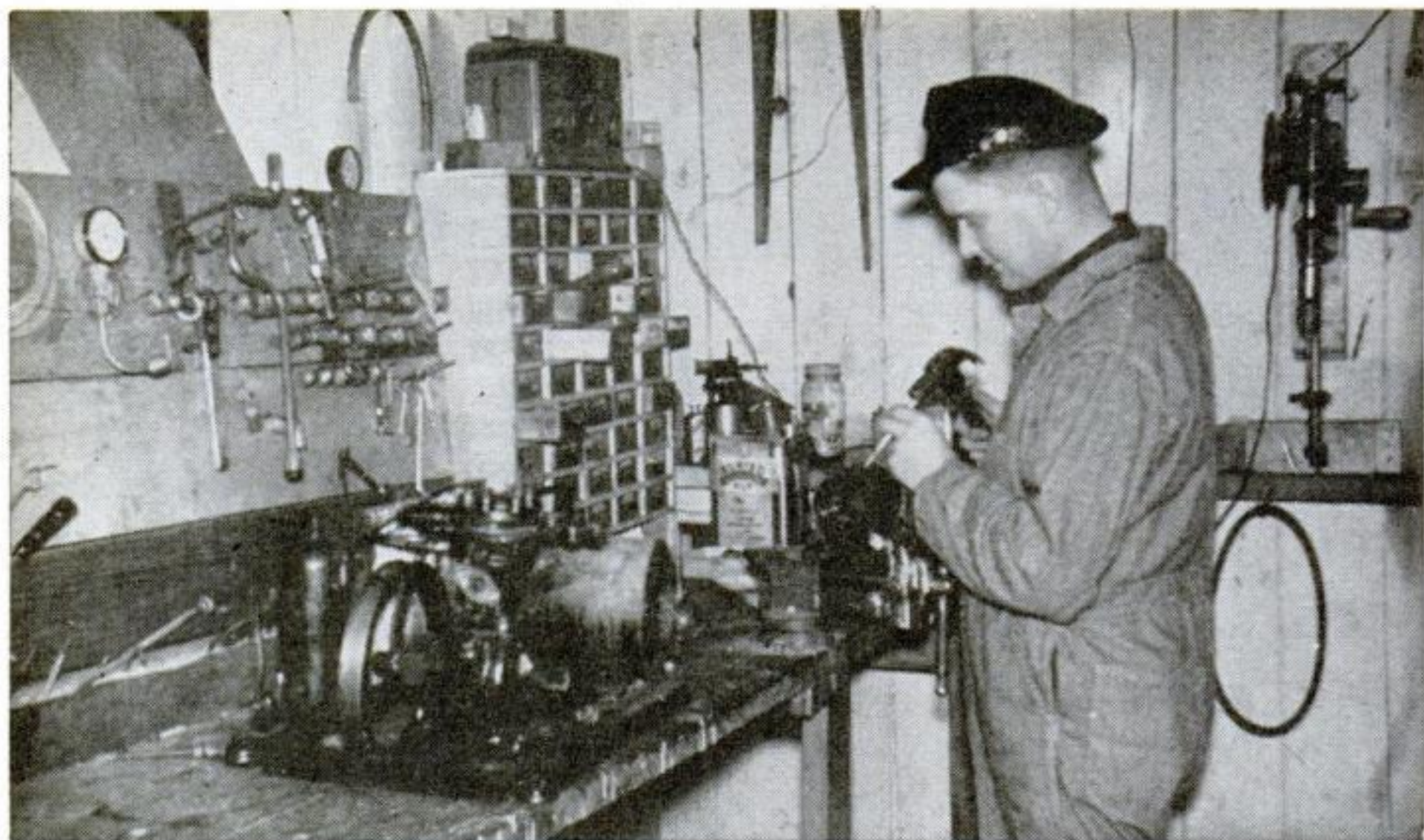
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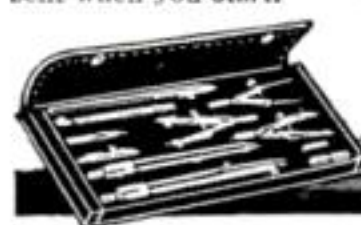
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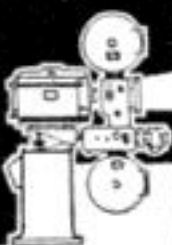
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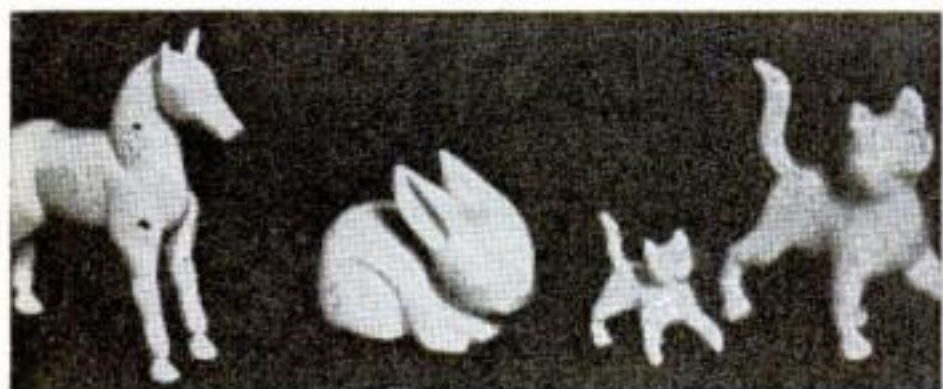
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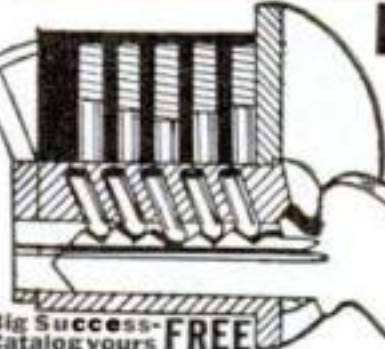
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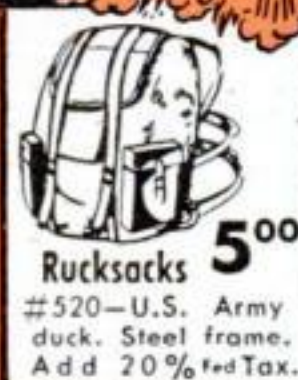
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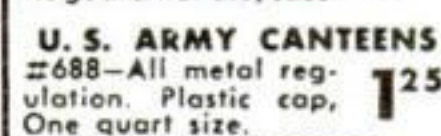
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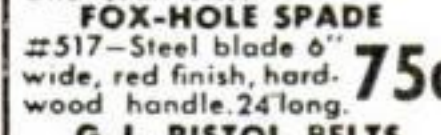
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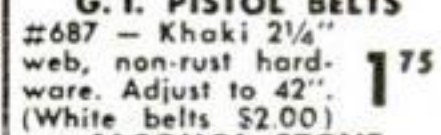
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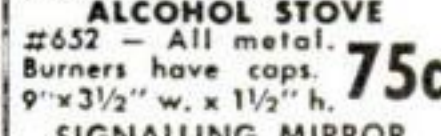
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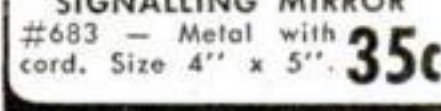
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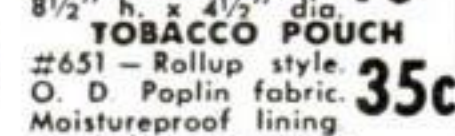
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Burners have caps.
9" x 3 1/2" w. x 1 1/2" h.
75c



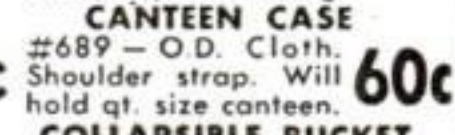
SIGNALLING MIRROR
#683—Metal with
cord. Size 4" x 5".
35c



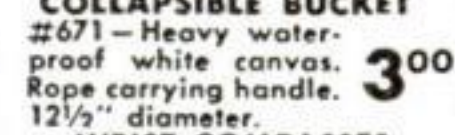
COLEMAN G. I. STOVE
#632—Sensational!
Metal telescoping
case. Burns gasoline
8 1/2" h. x 4 1/2" dia.
10⁹⁵



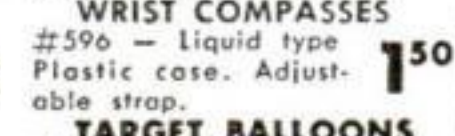
TOBACCO POUCH
#651—Rollup style.
O. D. Poplin fabric.
Moistureproof lining
35c



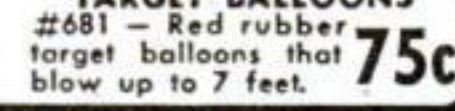
CANTEN CASE
#689—O.D. Cloth.
Shoulder strap. Will
hold qt. size canteen.
60c



COLLAPSIBLE BUCKET
#671—Heavy water-
proof white canvas.
Rope carrying handle.
12 1/2" diameter.
3⁰⁰



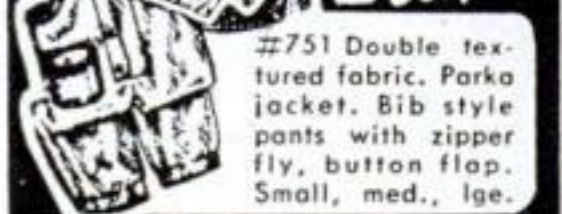
WRIST COMPASSES
#596—Liquid type
Plastic case. Adjust-
able strap.
1⁵⁰



TARGET BALLOONS
#681—Red rubber
target balloons that
blow up to 7 feet.
75c



100%
WEATHER
PROOF
2 PIECE
STORM
SUIT
7⁰⁰
#751 Double tex-
tured fabric. Parka
jacket. Bib style
pants with zipper
fly, button flap.
Small, med., lge.



25 Pc.
Camp-Scout
Kits
3⁵⁰
#514—Plastic case. Has scout
knife, safety razor, blades,
plastic oil can, whistle, fire
tabs.



Army Angle
Flashlights
#700—Plas-
tic case. Metal
clip. 2 bulbs (1 in
cap), 2 batteries
included.
1⁷⁵



Pocket Size Heatab Stove
#639
Metal,
folds flat.
Comp. with
10 Heatabs.
1⁰⁰



U.S.N. Sheath Knife
#703—Parker-
ized no-glore 6"
blade. Leather
washer handle.
Genuine leather
sheath.
2⁵⁰

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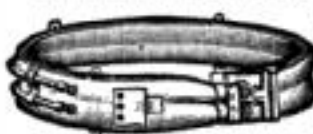
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118—Plastic—Each... **69c**



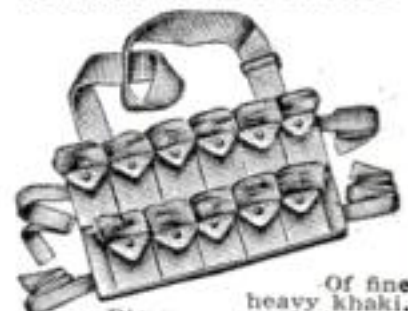
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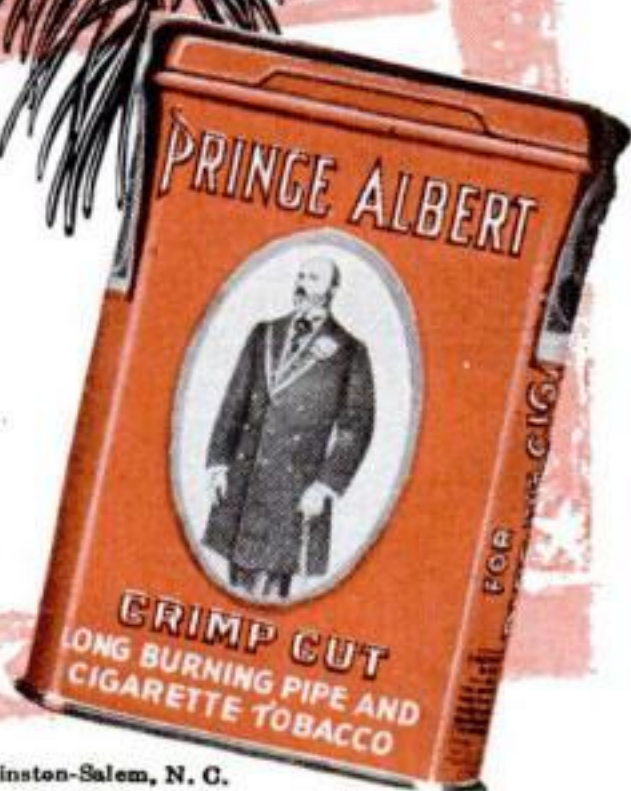


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BIGGEST TANK is Newest Antique

THIS LUMBERING MONSTER, the largest tank ever built for the U.S. Army, was designed to crack Germany's West Wall — but American troops were behind that fortification before T-28 could fire a shot. Recently unwrapped at Aberdeen Proving Grounds, it weighs 100 tons, mounts a 105-mm. gun, is already obsolete for atomic warfare.

Are Workshopppers

By HAL BORLAND

IN CHICAGO there is a steely-faced banker who would rather duck into his cellar on a sunny Saturday than shoot 19 holes of golf. In Hollywood there is a movie actor who prefers tinkering with old clocks to night-clubbing along the Strip. In Boston there is an auto mechanic who passes up the movies to sneak back to the shop and whittle bronze into chessmen. All over America, the breed of male who keeps the cellar light on half the night is increasing.

Who are these artists who scorn the conventional pastimes, and why do they do it? To be blunt: *Are workshopppers wacky?* Most of their wives think so, and some of their best friends are sure of it.

But what is a workshoppper, anyway?

That's not so easy to answer—and maybe that is one way of replying to the charge of wackiness—for outwardly the man looks



normal. A little more contented, perhaps. Probably a little more competent in carving up the Christmas turkey. But what makes the workshoppper different from his fellow clerks, vice-presidents, and machine operators is an appreciation of the well-made thingumajig, plus the ability to use his hands as well as his head.

Your workshoppper likes to make things for himself. And he knows how: how to run a lathe or a band saw, how to read a micrometer or an oscilloscope, how to mix developer or paint. So he spends hours making



something he might buy for a fraction of its time-cost. But in his own shop he can afford to hire himself, and his product is as personal as a baby, bringing out the usual smugness of paternity.

Who is he? He is the lawyer who relaxes from the courtroom by making inlaid wooden bowls on a lathe. He is the accountant who clears his mind of statistics by carving figurines from plastic. He is the writer who "wastes" a day making a fancy belt for his wife out of a worn-out pair of boots.

There are probably 10,000,000 of his kind here in America, men who have developed skills and ingenuities that add immeasurably to their lives. They aren't a new breed. Their American line goes clear back to Franklin and Whitney, and it comes down through Henry Ford, who mended clocks and dreamed of building an automobile; through the Wright brothers, who ran a bicycle shop



WACKY?



Hal Borland is no newcomer to the pages of POPULAR SCIENCE MONTHLY. A special writer for nearly 20 years, his articles, essays, poetry and fiction have covered many facets of American life. His latest book, "An American Year," was published last spring.

and dreamed of flying; through "Boss" Kettering, who worked with telephones and dreamed of building a self-starter for the automobile.

It is inevitable that in our specialized modern life we should turn from the job to something wholly different. The human mind needs more than one narrow track. That explains the dentist who is far prouder of his intricately carved tabletops than of his best dental inlays. It explains the doctor who would rather make a new fly rod than attend a medical convention. And that's why one famous musician is reluctant to make more than one concert tour a year—he begrudges the time he could otherwise spend in his workshop designing new tools for industry.

In his shop the workshopper is his own



boss. His time is his own, and so are his materials. When he has finished, the product is his; so are all the things he learned along the way, and so is the deep pride of personal achievement.

Sometimes the workshopper develops his manual skills on a doctor's orders. Handwork has a healing effect on those under severe mental strain. A well-known German editor came here as a political refugee and in a sanitarium learned to use his hands at a lathe. Physically recovered, he resumed his writing, but his hand-turned bowls and trays are now better known than his books. He would

never have done that abroad; it would have been beneath his dignity, and neither tools nor materials would have been readily avail-



able. Here in America, any man can equip his own shop with excellent power tools for relatively little money. And there is respect here for any job well done.

America has always had room for the man who could make things. The pioneers made their own furniture and most of their own tools, of necessity, and those who proved most adept at it soon had a respected craft. Out of their skills and imagination came still other crafts, and as demand increased they invented new tools, new methods. From water power they turned to steam, and eventually to electricity. Today the workshop of even the most casual home craftsman has tools that would have been unbelievable to Eli Whitney.

The workshopper of today has electricity for power—clean, compact, and quiet. If he works in wood he probably has a lathe, a drill press, a sander, and a power saw. If metal is his medium he probably has a precision lathe, a drill press, a router, and dozens of special attachments. If he works in radio or electronics, he has gauges and meters, vacuum tubes and condensers. Even such a simple tool as his electric soldering iron would have been a marvel anywhere 50 years ago. If he is a photographer, he has a

whole cabinetful of chemicals, hot and cold running water, any kind of light he wishes, his own enlarger, and a wide choice of printing papers.

Even specialized knowledge is his for the taking. Fundamentals are available in school textbooks, and beyond these are bookstores, libraries and magazines, popular and technical, for background information or current developments. And for broader schooling in any field, there are night schools and correspondence and extension courses. The workshopper today has a base of known fact from which to work, and whatever he can add to it is new knowledge, his own contribution.

The Inner Glow

There lies one of the deepest urges of the serious workshopper: He can contribute. True, nine out of every ten of those working in a basement shop are working for their own satisfaction. Their time is not wasted, however, for inner satisfaction, the glow of accomplishment, is important to any person. And the tenth one is, in effect, a lone researcher seeking new truth. Sometimes he finds it.

Edison started as a workshopper. Go over the inventions of the past half-century and you will find dozens of such men, who worked alone in their spare-time shops or laboratories—questioning, seeking, eventually finding.

No, most of those in today's home workshops are not inventors. They are craftsmen. I remember the executive whom I found at home one Sunday morning making a pair of plastic link pins for his small daughter's wrist watch. He might have bought those pins at a jeweler's, any day but Sunday. But his daughter wanted to wear the watch that day, and she was firmly convinced that her father could make anything. So he made those pins, turned and polished and fitted them. On a time-cost basis they probably represented close to \$50, for he is a high-salaried executive. I suspect that he actually got at least \$100 worth of satisfaction out of the job—not to mention the fact that he further enhanced

his reputation as a capable, versatile father.

The workshopper has any number of reasons to offer for his part-time preoccupation. There is a surgeon who keeps both mind and fingers supple by doing miniature woodcarvings, mostly of animals. There is a physicist who carves costume jewelry out of nuts. He says it satisfies his artistic sense. And there is the architect who makes scale-model trains because, as he says, it keeps his mind aware of the detail necessary in his daily job. All these men, of course, get the mental stimulus of handcraft and the relaxation of concentrating on something wholly different from their daily jobs.

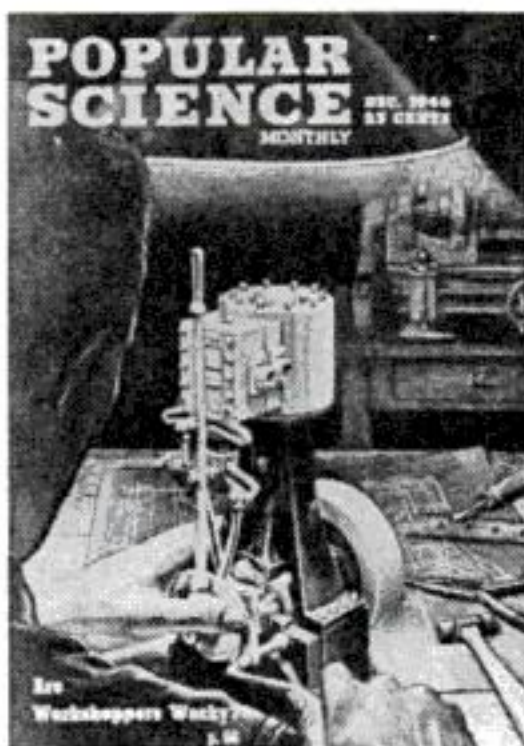
You will sometimes find a man who holes up in his workshop to get away from a nagging wife or demanding children. At least, he is doing something constructive, and he is probably wiser than the man who goes down to the tavern to get away from it all.

A Collector at Heart

Occasionally, too, you strike the magpie type of workshopper who accumulates tools and materials and spends most of his spare time listing them and keeping them free from rust. Even he is no worse at heart, I suspect, than the stamp collector.

But for the most part the man in the workshop is a good average citizen who knows, or wants to learn, what makes things tick. When he buys an automobile, he wants to know about its bearings and its ignition as well as its paint and upholstery. When he buys or builds a house he checks on its foundation and its piping as well as the view from the picture window.

Why does he cling to that workshop? Because it is his own kingdom. It is the place where he can prove to himself that his own industry and ingenuity have their value. He can adventure there as he will. He can make a shelf to hold his wife's kitchen spices, or he can build a canoe with which to explore the near-by river, or he can build a telescope with which to reach out to remote galaxies. He can undertake anything his imagination or ambition suggests, and his success or failure in that undertaking is wholly dependent upon his own resources.



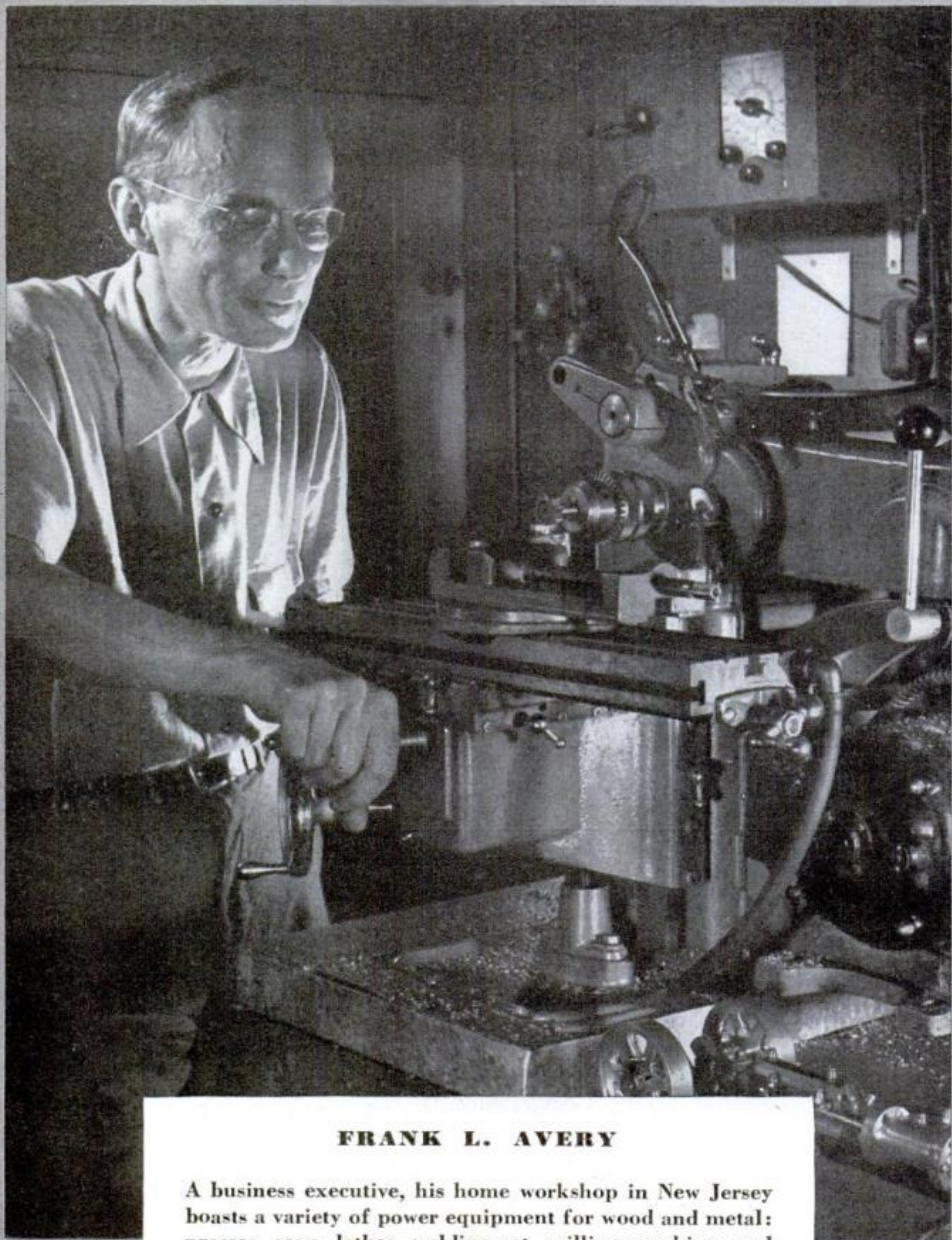
COVER: This painting by Ray Pioch illustrates the dream of many a top-flight workshopper—a real single-cylinder, double-acting steam engine, plans for which will appear in PSM.



An ALBUM of American Workshoppers

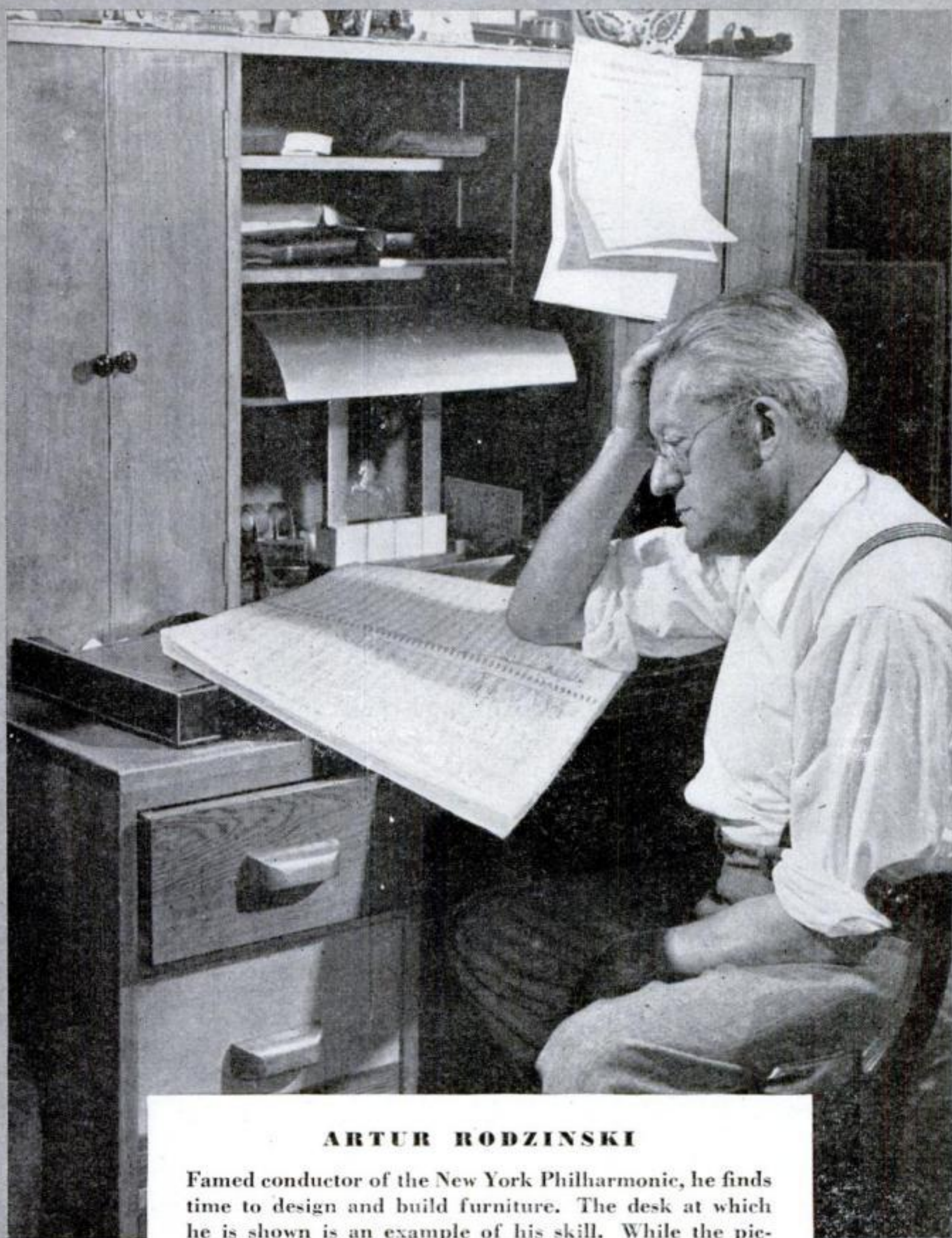
HENRY R. DIAMOND

An artist by profession, his hobby is woodworking and furniture design. His Long Island home contains many products of the cellar workshop where he combines artistry and craftsmanship to create furnishings and fixtures that range from a beamed living-room ceiling to a studio couch with built-in space for storage and books.



FRANK L. AVERY

A business executive, his home workshop in New Jersey boasts a variety of power equipment for wood and metal: presses, saws, lathes, welding set, milling machine, and a foundry for small castings. During the war he taught a class for shop foremen. Here, he is milling a part for the model steam engine shown at lower right.



ARTUR RODZINSKI

Famed conductor of the New York Philharmonic, he finds time to design and build furniture. The desk at which he is shown is an example of his skill. While the picture was being made, he also discussed a bedside radio installation, matched darkroom lore with photographer. Without a workshop at present, he is planning a new one.



BOB BURNS

A radio comedian who classifies himself as a farmer, his chief hobby is precision woodworking. His workshop activities, however, extend to general tinkering, home mechanics, and inventing gadgets, several of which he has put to use on his California ranch. Here, at his workbench, he adjusts a vane on a miniature windmill.



DONALD R. DOREMUS

He counts photography, archery, gunsmithing, metal- and woodworking among his many hobbies, and his New Jersey workshop—planned with an eye to all of them—even includes a pistol range. Some of its equipment he had to design himself to satisfy the demands of his varied interests. His job is assembler in a steel works.



HARRY HYDER

Radio is his work as well as his hobby. He devotes his days to designing commercial receivers, his evenings to building ham and experimental equipment—or writing about it. His first article, sold to PSM, dealt with the two-meter set he is checking here. A marine radio operator during the war, he holds ham license W2LIW.



BRIAN DONLEVY

A film star known to millions of theater-goers, he is no more immune to the workshop bug than any other American. Between pictures, his hobby is carpentry and cabinetwork, but the variety of tools above his workbench suggests the diversity of his other interests. Here he is engaged in sharpening a pair of hedge shears.



LESTER D. FRIEND

Owner of a Massachusetts paper-box factory, his workshop talents are devoted to turning out scale-model, live-steam locomotives. President of the New England Live Steamers, Inc., he operates a machine shop that produces parts for other model makers, and he has turned his factory grounds over to them to accommodate track.

Willys Springs

a New One

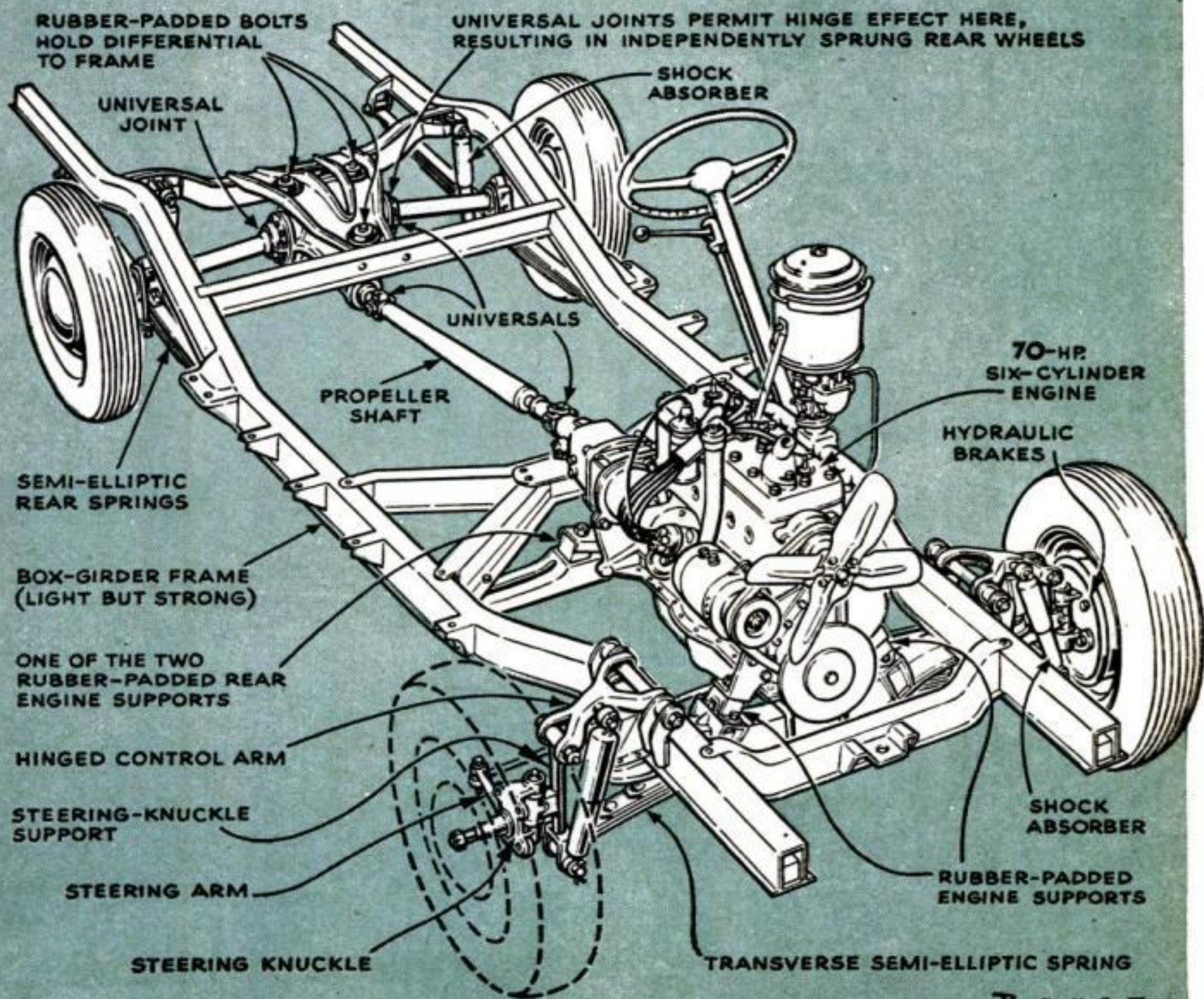


DESCRIBED as the first American stock car with independent suspension of all four wheels, the Willys-Overland 6-70 is a new entry in the lightweight division for 1947. A sedan seating three in front and two in the rear with room to spare, it has a wheelbase of 104 inches and weighs about 2,500 pounds.

Individual suspension of the rear wheels is achieved by using universal joints where the axles enter the differential. In front,

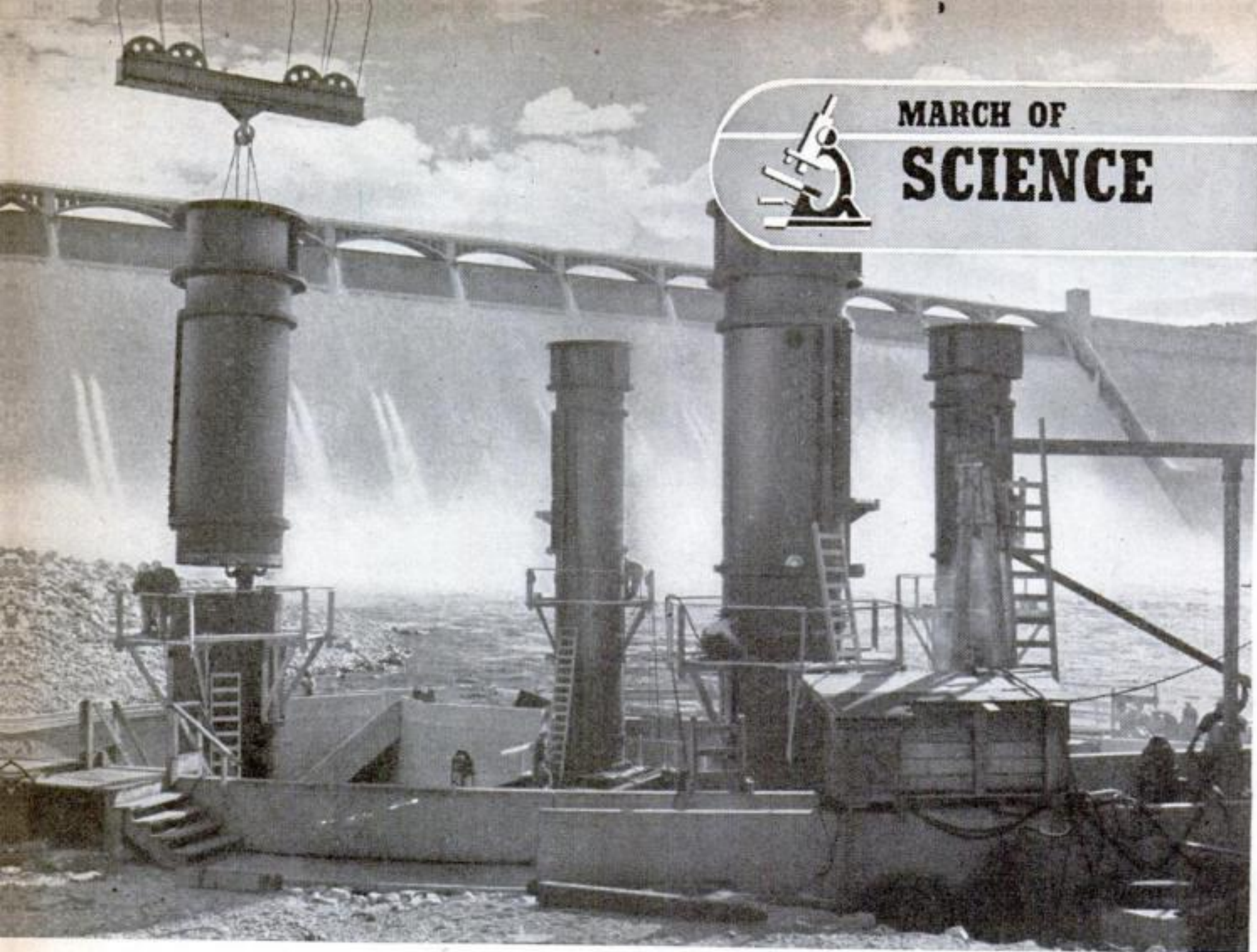
the traditional axle is replaced by a transverse spring connected to steering-gear assemblies. Rubber inserts in the spring make lubrication unnecessary.

As its name implies, the car has a six-cylinder, 70-horsepower engine, designed to give 31 miles to the gallon at 30 m.p.h. and a top speed of 78 m.p.h. Because Willys is maintaining priority for its utility Jeep line, the new model will not be put into production until mid-1947.



ROUSE

DEC. 1946 77

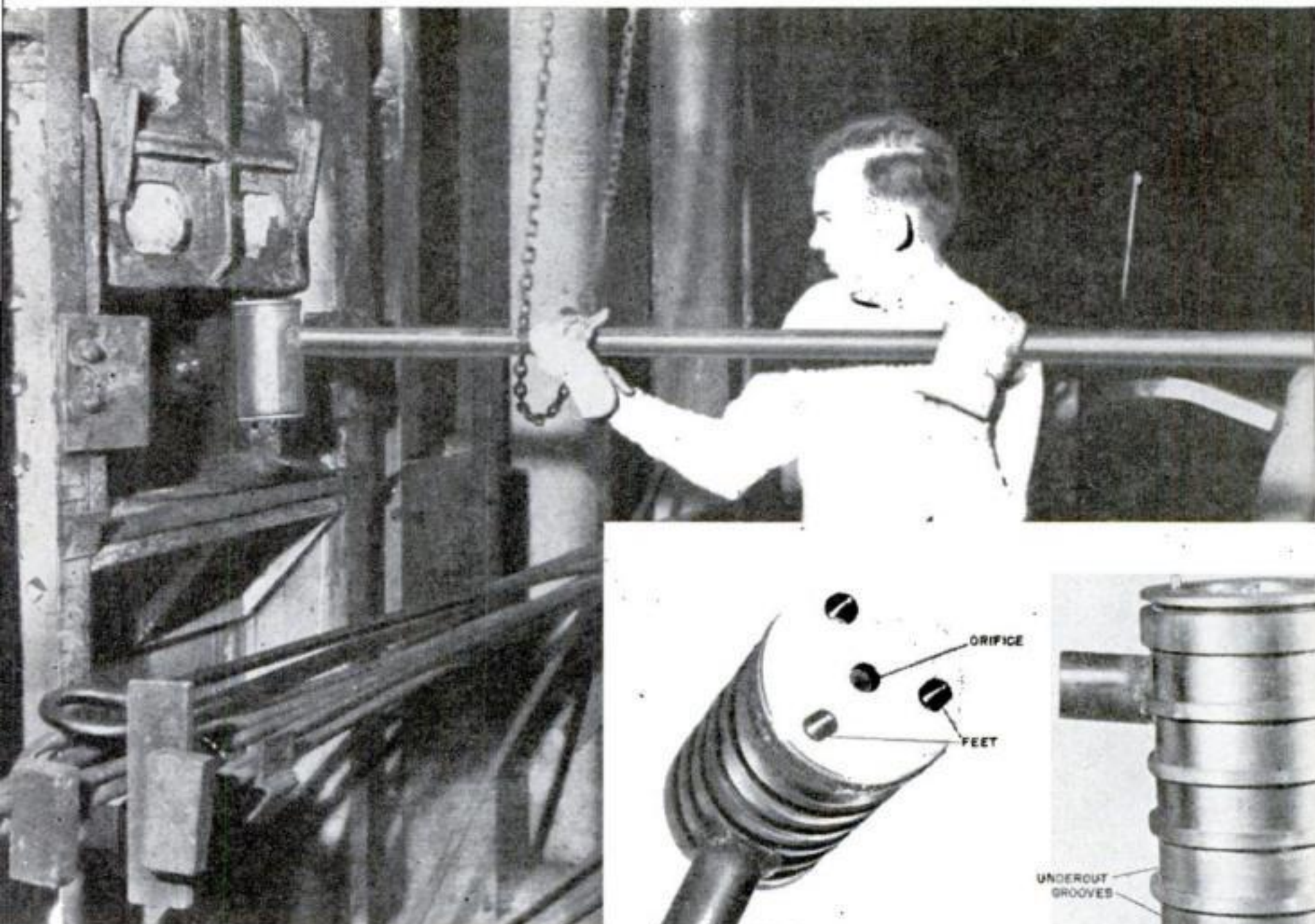


Dam "Submarine." Steel access tubes $7\frac{1}{2}$ feet in diameter are shown above being fitted to a huge caisson at Grand Coulee Dam, Wash. The caisson, to be floated to the dam when ready, will permit workers to repair a damaged spillway bucket. Air, materials, and service lines will be fed to an underwater working chamber through the tubes, one of which contains an elevator. A rubber seal keeps water out.

Camera Prints Its Own.

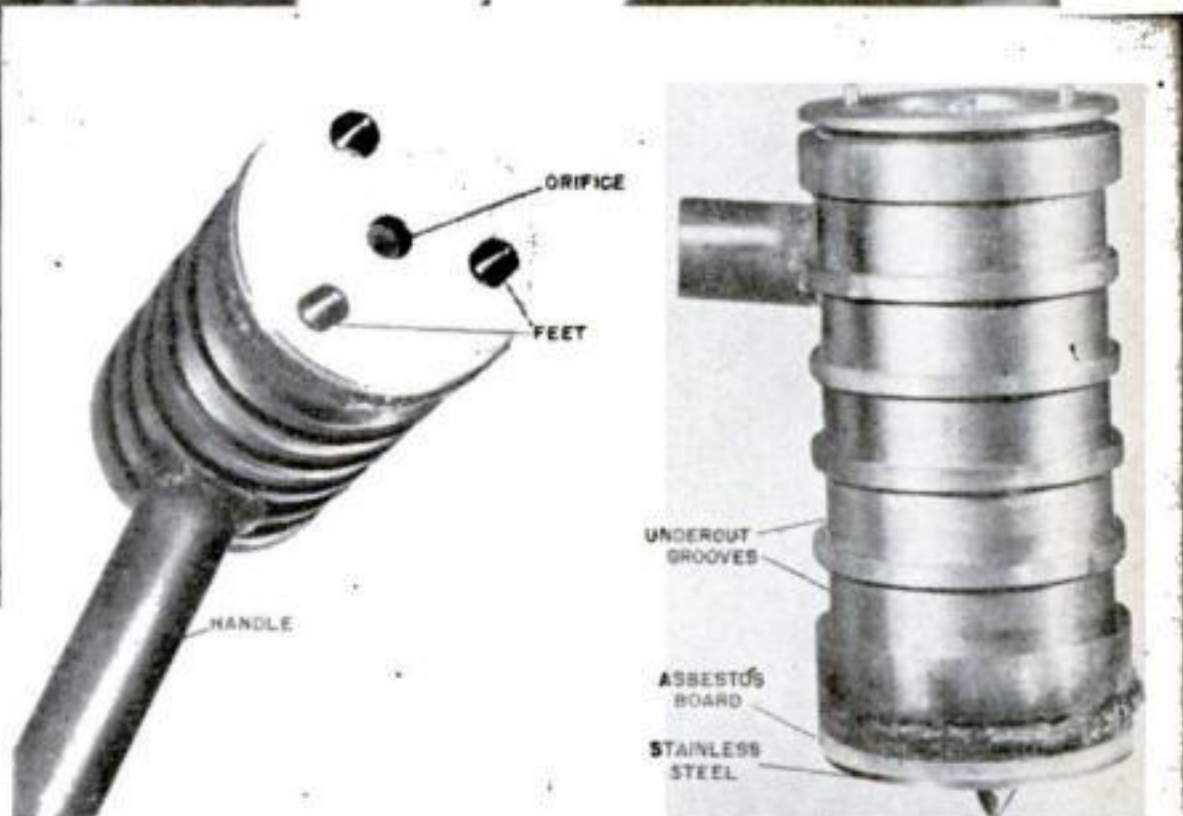
Entirely automatic, the supercamera at right takes a picture, develops it, and throws it on a screen in 15 seconds. Designed secretly during the war by Eastman Kodak Co., it takes photos at a $1/10,000$ -second speed on special 16-mm. film. A container squirts chemicals heated to 140° F. on the film and a vacuum processes the picture in 9 seconds. It is then ready for the projector.



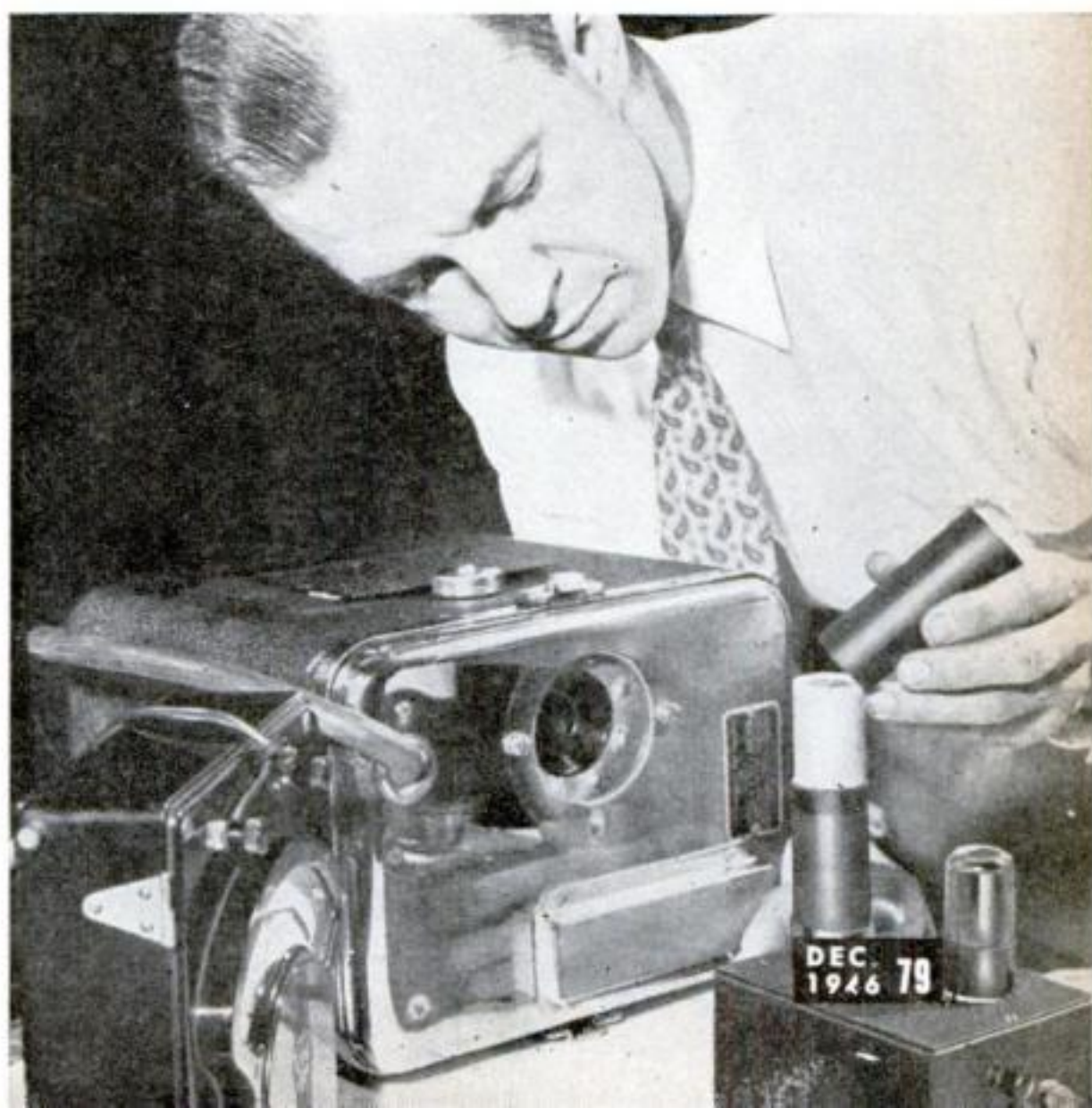


Taking Steel's Temperature. To test temperatures of white-hot steel slabs while they are in a furnace, U. S. Steel has devised a new, long-handled, heat recorder. The water-cooled head (inset) is rested on a slab and picks up heat radiations through an eye in its bottom. Wires through handle transmit reading to recording potentiometer. Surface temperatures to 2,400 degrees F. can be measured.

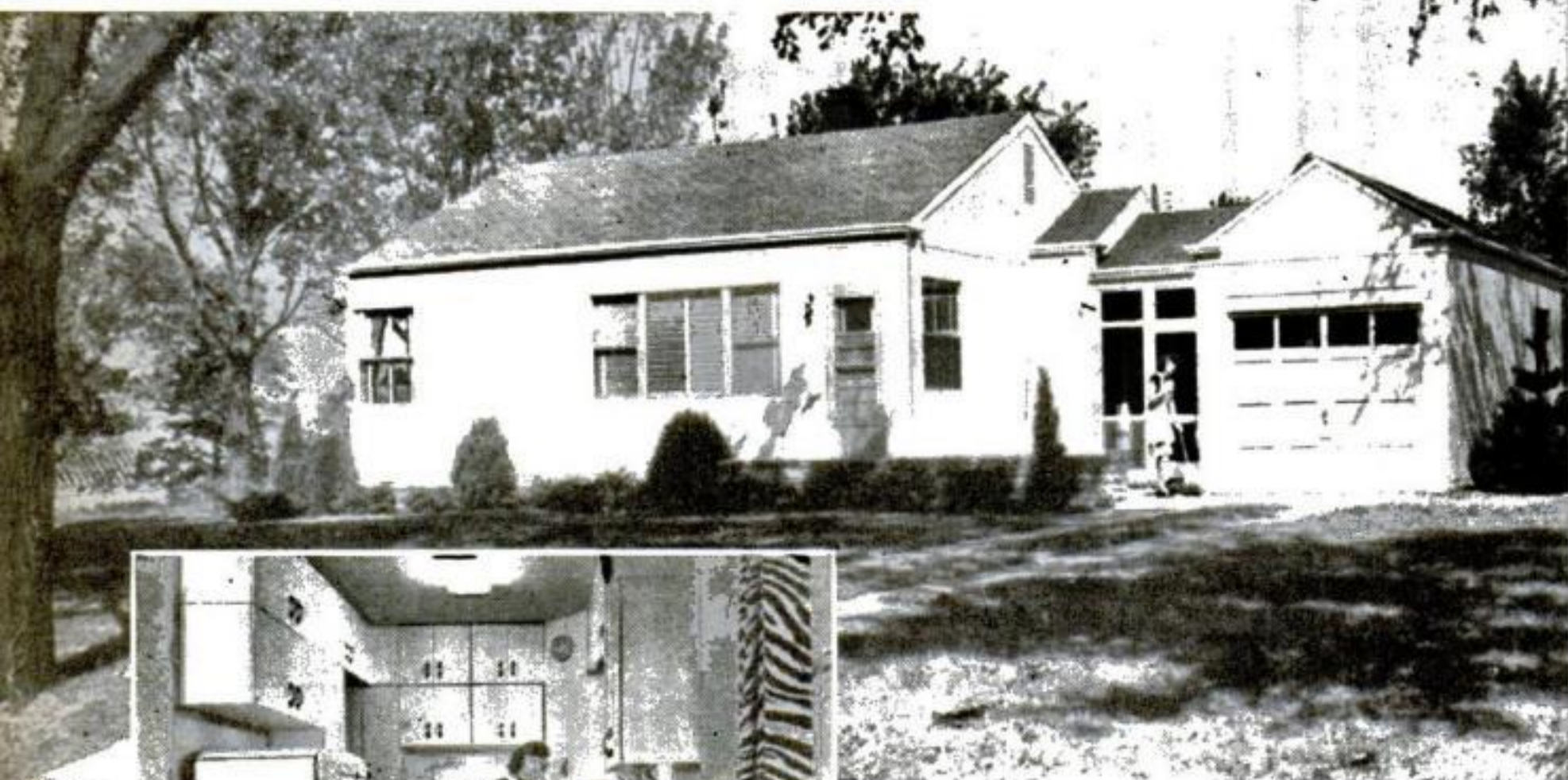
X-Ray Detective. By giving a small electronic photomultiplier tube a fluorescent vest and a black paper coat, Westinghouse has developed an X-ray counter (right) that covers a wide intensity range. The black coat blocks out room light but lets X-rays reach the fluorescent screen. The tube then measures the intensity of fluorescence and records changes as rapidly as 1/1,000,000-second.



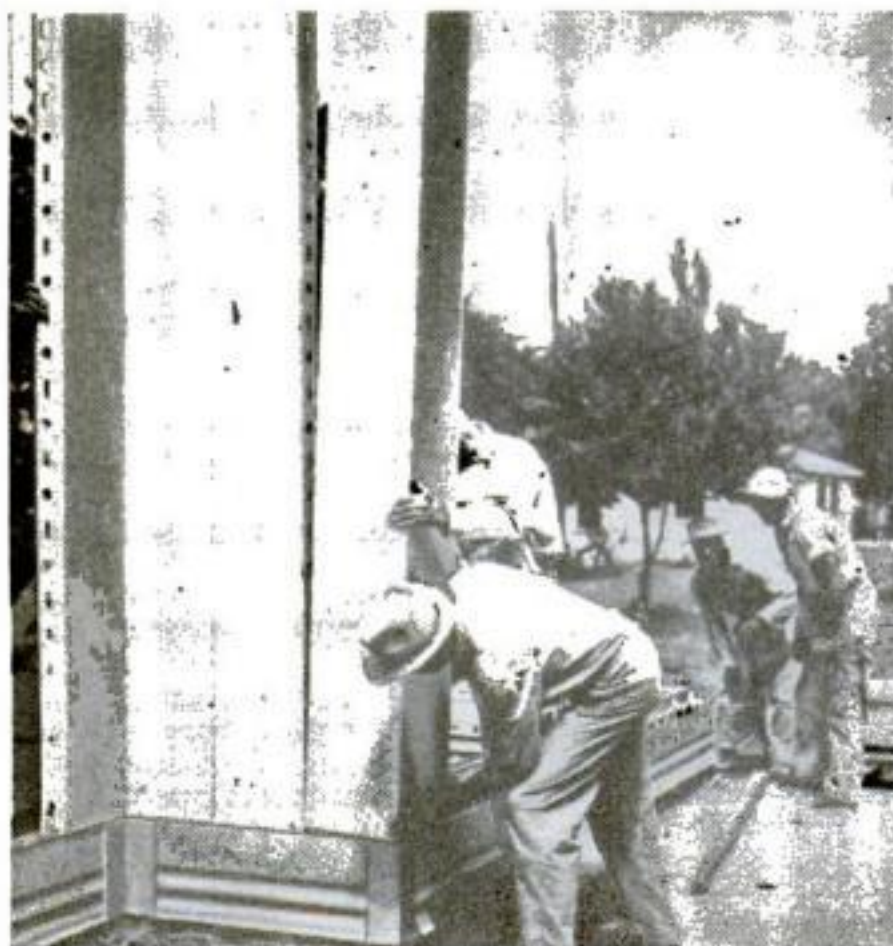
SURFACE PYROMETER BOTTOM AND SIDE VIEW.



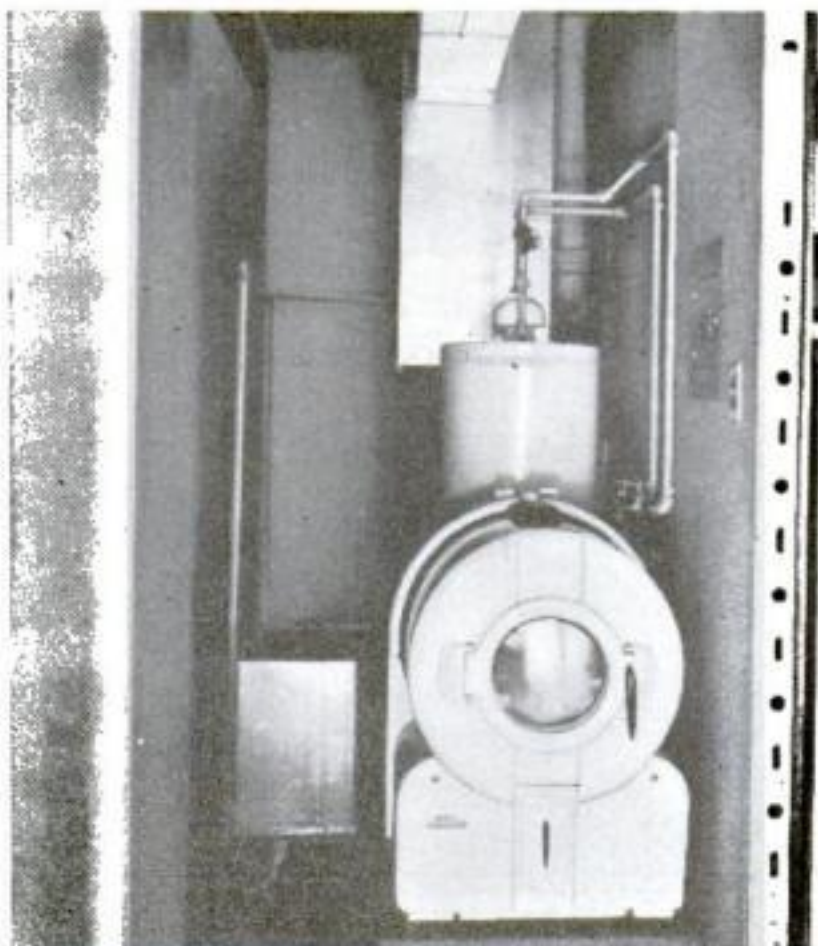
FLYWEIGHT HOMES



A new and unusually light prefabricated unit to combat the housing shortage is the "Boulevard Aluminum Home" shown above. Made by the Butler Manufacturing Company, of Galesburg, Ill., the two-bedroom structure is 24 by 33 feet. Wall panels are aluminum but the house contains 2,300 pounds of steel, most of it in rafters for the roof. The modern kitchen at left is part of the package.



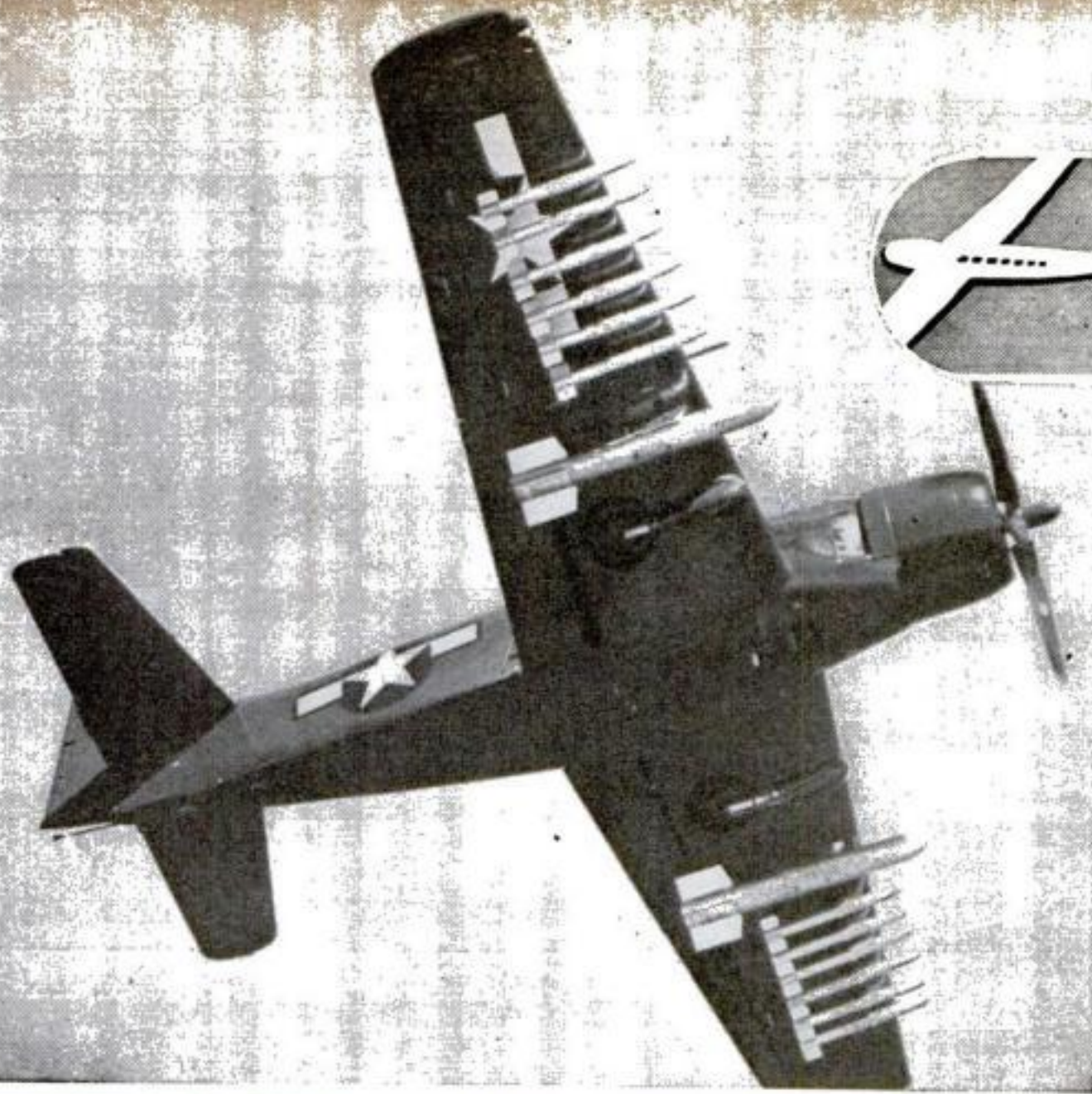
Workers assemble the aluminum panels, which will not warp, burn, rot, or rust. The house can be set up in about two-and-a-half weeks.



Washing machine, furnace, and hot-water heater are shoehorned into the utility room. If house has basement, the room becomes a stair well.

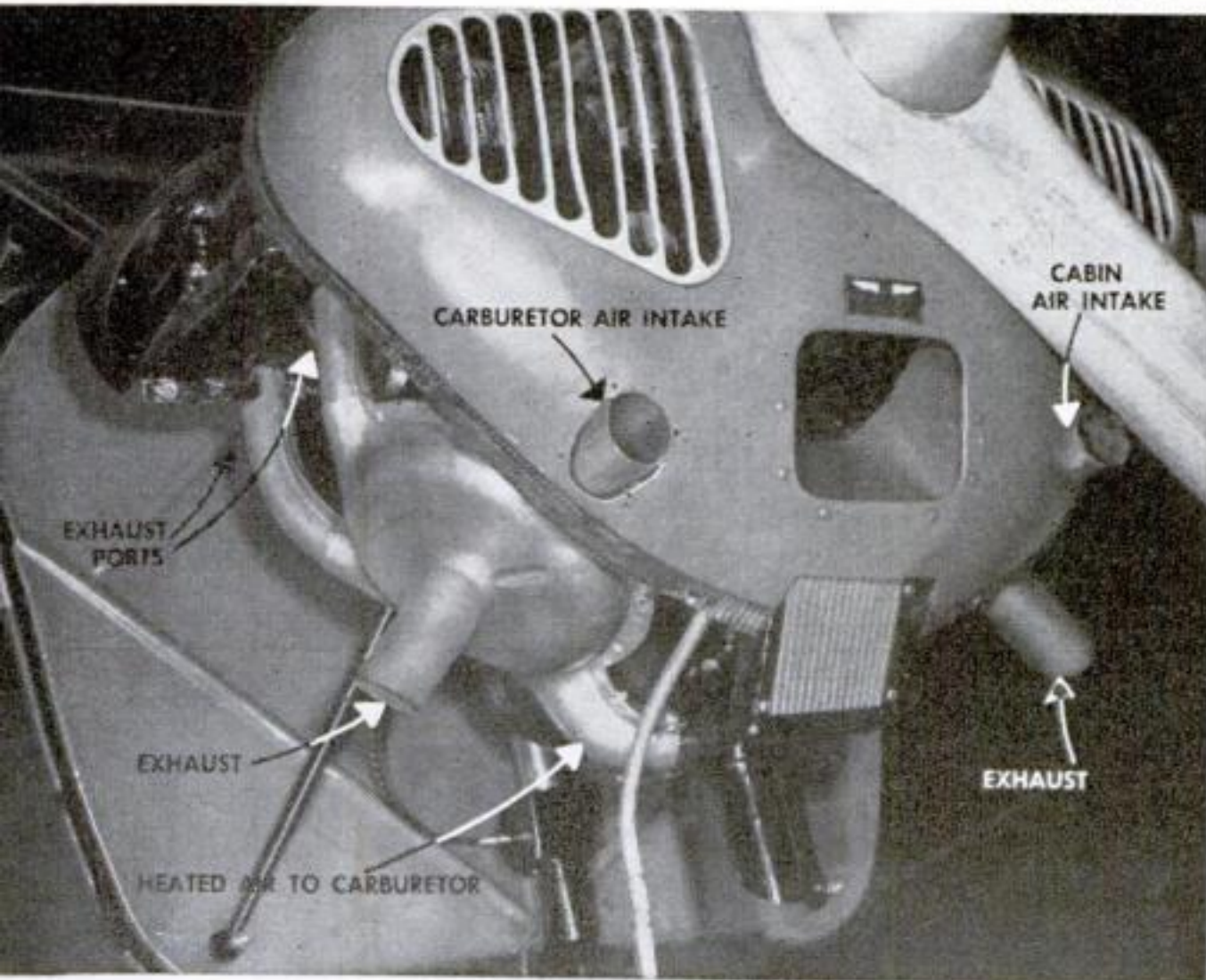


WHAT'S NEW in AVIATION



Rocket Raider.

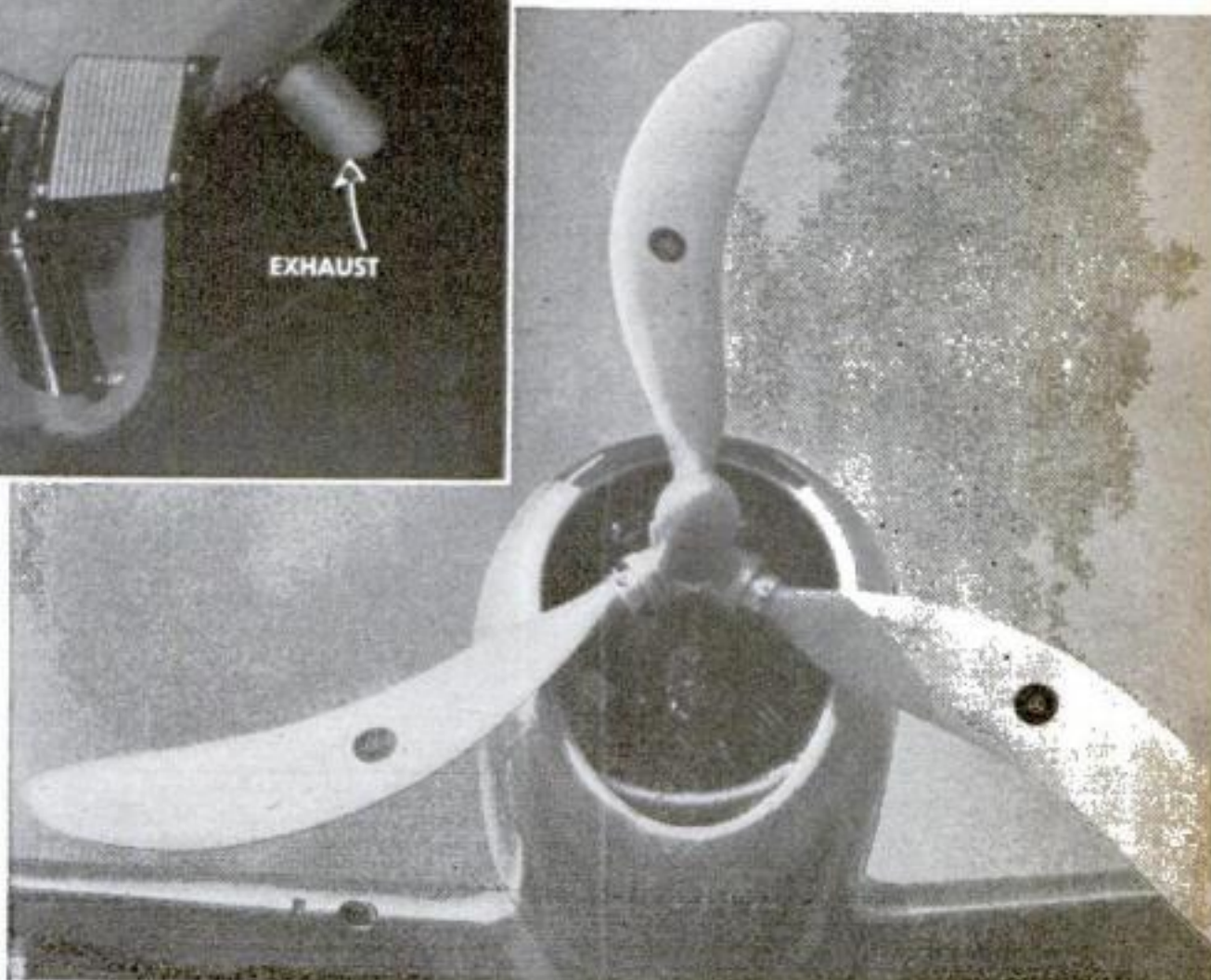
Packing the firepower of a broadside from the guns of a light cruiser, the Navy's first Douglas AD-1 Skyraider is shown at left with batteries of five-inch and 12-inch rockets under its wings. This new type of seagoing attack craft can carry 6,000 pounds of munitions on long flights.



Ear-Saver. The eight-pound muffler at left forms a complete exhaust system and swallows 90 percent of aircraft engine noises. Developed by Ryan Aeronautical Co., it is designed for planes powered by 65-85 hp. engines. The system heats carburetor air and also directs warm air into the aircraft's cabin.

Sway-Back Prop.

Swept-back blades (right) feature Curtiss-Wright's new propeller, designed for use on future Army planes that may rival turbo-jets in efficiency at speeds up to 700 m.p.h., with much greater efficiency at lower speeds.



WHAT'S NEW in AVIATION

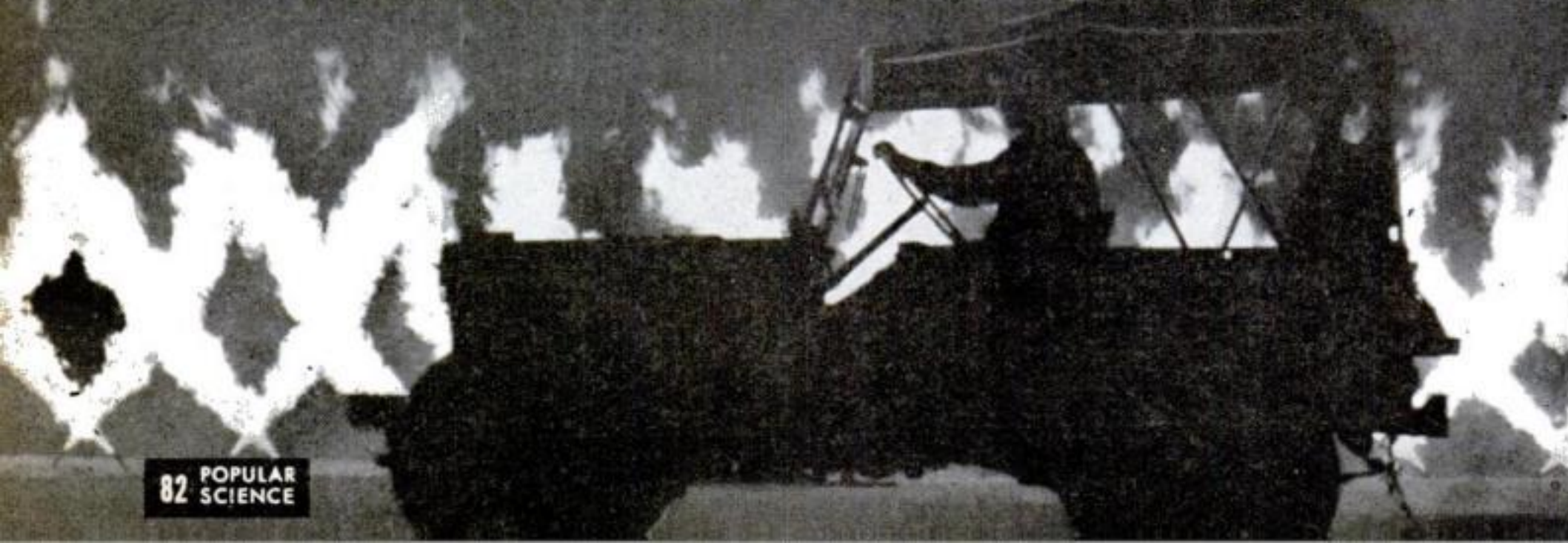


Gliding out of a fog and into fair visibility, a C-47 prepares to land at the Navy's Landing Aids Experiment Station, Arcata, Calif. The flames burning off the mist are part of a new fog-dispersion system called ELMER—a refinement of Britain's wartime FIDO.

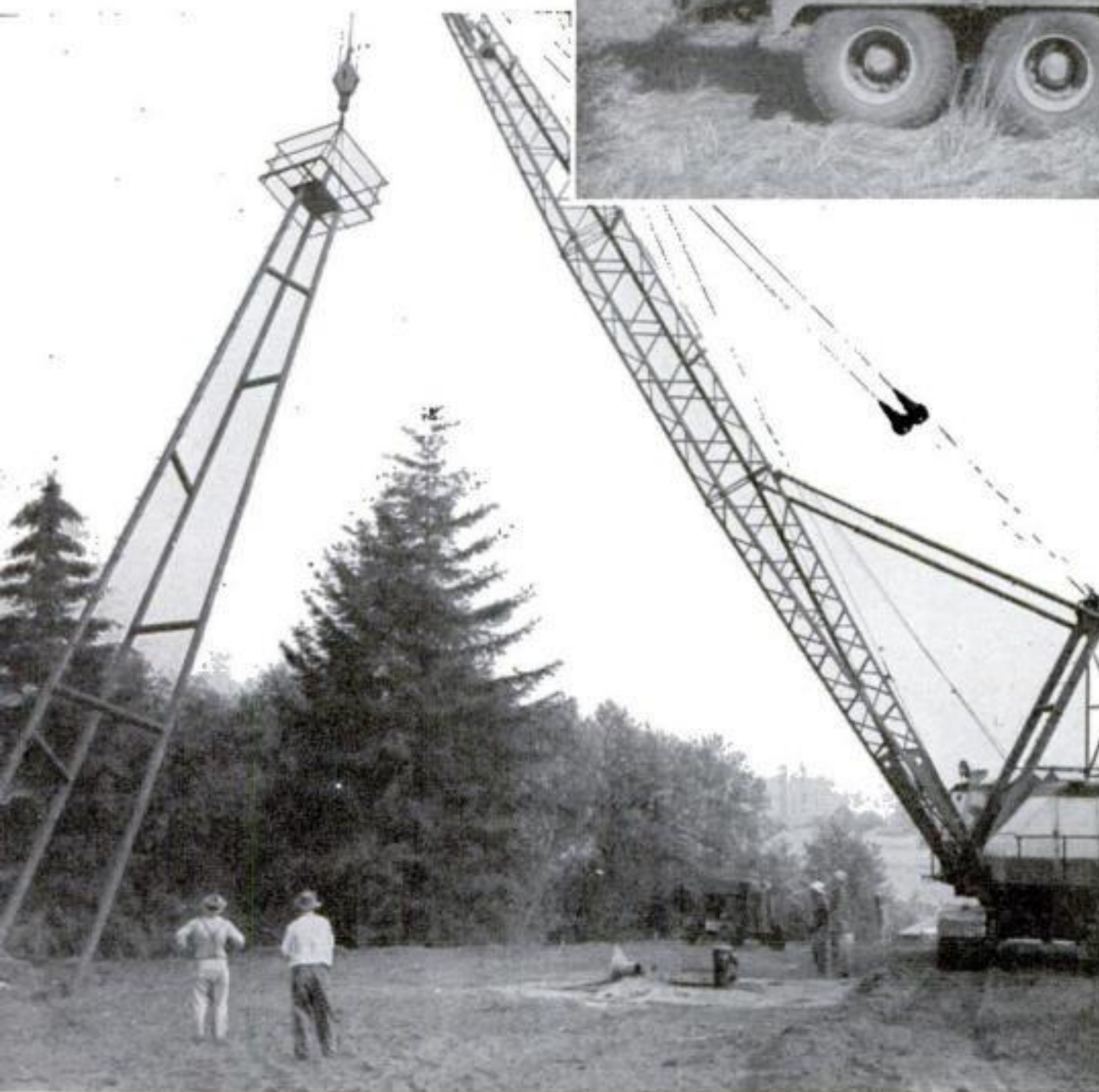
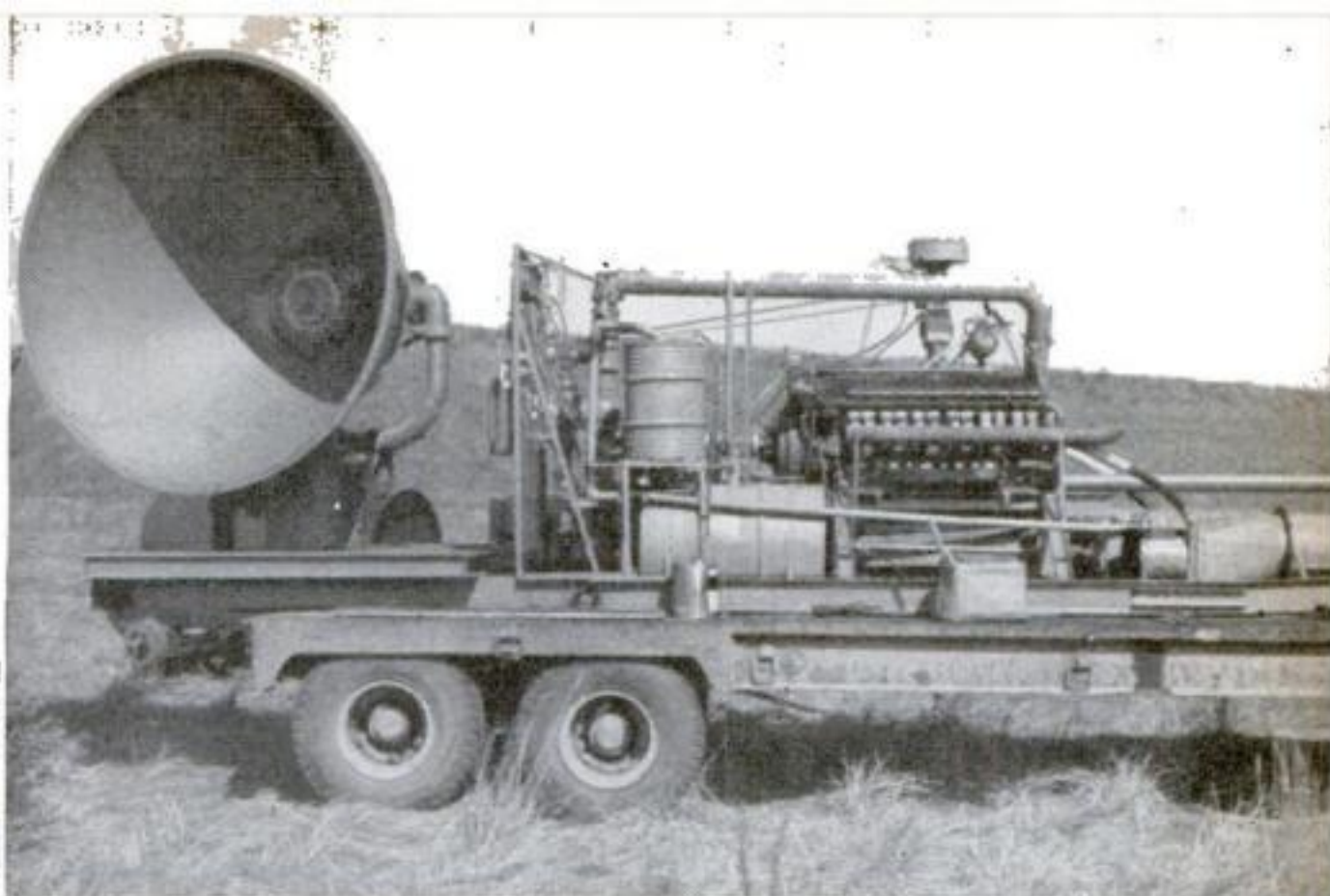
At a central control board, an operator turns on lights and fog-chasing burners at Arcata. ELMER has cut the costs of landing a plane in a fog to \$150 as compared with the \$4,000 average expense of using FIDO.

ELMER, in full glory below, is a line of tri-nozzle heads that atomize Diesel oil under high pressure and shoot curtains of flame into the air on both sides of the runway to vaporize the fog. A hot-wire setup provides instantaneous ignition of the oil.

NEW TRICKS for FIDO



Most unusual medium used in fog-dispelling is sound. Fog particles bombarded by sound waves collide, form heavier drops and fall as rain. Recently, however, the noise of a battery of 12 sirens nauseated personnel. Now the Navy thinks it can beat this with ultrasonic waves that humans can't hear. At right is a generator and horn built by Ultrasonic Corp.



Fog is also being routed by light. Workmen above raise one of 38 towers carrying approach lights at Arcata. The 75-foot tripod standards are arranged in two rows of 19 each along a 3,500-foot approach

zone. They give the Naval station the most brilliant airport lighting in the U. S. Above, right, is a 5,000-watt American Gas Accumulator Co. light, one of which is atop each of the towers.

Improved weapons enter the battle against airport fog.

FLAME, sound, and electric lights have all been drafted in the latest skirmish of the endless fight against the airplane's arch foe—fog. At Arcata, Calif., where the Navy has its Landing Aids Experiment Station, the Navy, Army, and United Air Lines are constantly improving on FIDO, the vaporization of fog by heat. FIDO (Fog Investigation and Dispersal Operations) was

initiated by the British during the war.

Even as they explore the possibilities of fire, light and sound, Government and commercial forces seek other new anti-fog weapons. Experimental curtains of wind and 100-foot screens of water are to be thrown up alongside runways. Drying agents will be tested. The battle will go on until our airports win freedom from fog.



Dishing Up "Dirt." Is restaurant dishwashing dangerous? The National Sanitation Foundation was worried about it and enlisted the scientific resources of Michigan State College to determine just how great a threat these methods are to public health. At left, Dr. W. L. Mallman, public health professor, prepares an artificial concoction containing food products similar to those found on dirty dishes. It was used to coat china for the tests.



Scientific Dishwashing

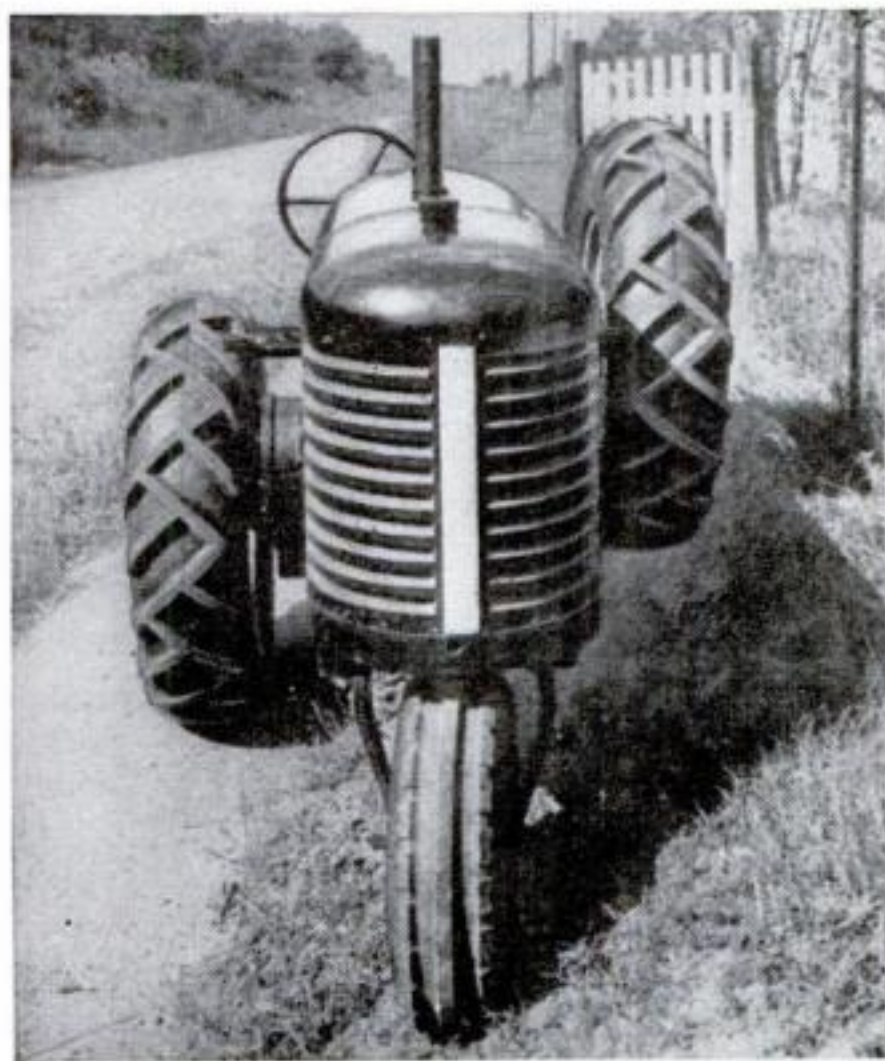


Watching the Wash. One conventional way in which cafes wash dishes is to place them in wire racks where they are then flushed with sprays of water. Above, Paul De Koning, associate professor at Michigan State, watches a machine do its stuff.

Tattletail Germs. By counting bacteria cultures, Dr. Mallman (left) found that machines wash dishes better than the human hand. However, he warns against dirty machines, improper loading of racks, too little cleanser, and low water pressures and temperatures. He recommends a 40-second wash in 140° F. water and 10-second rinse at 170°.



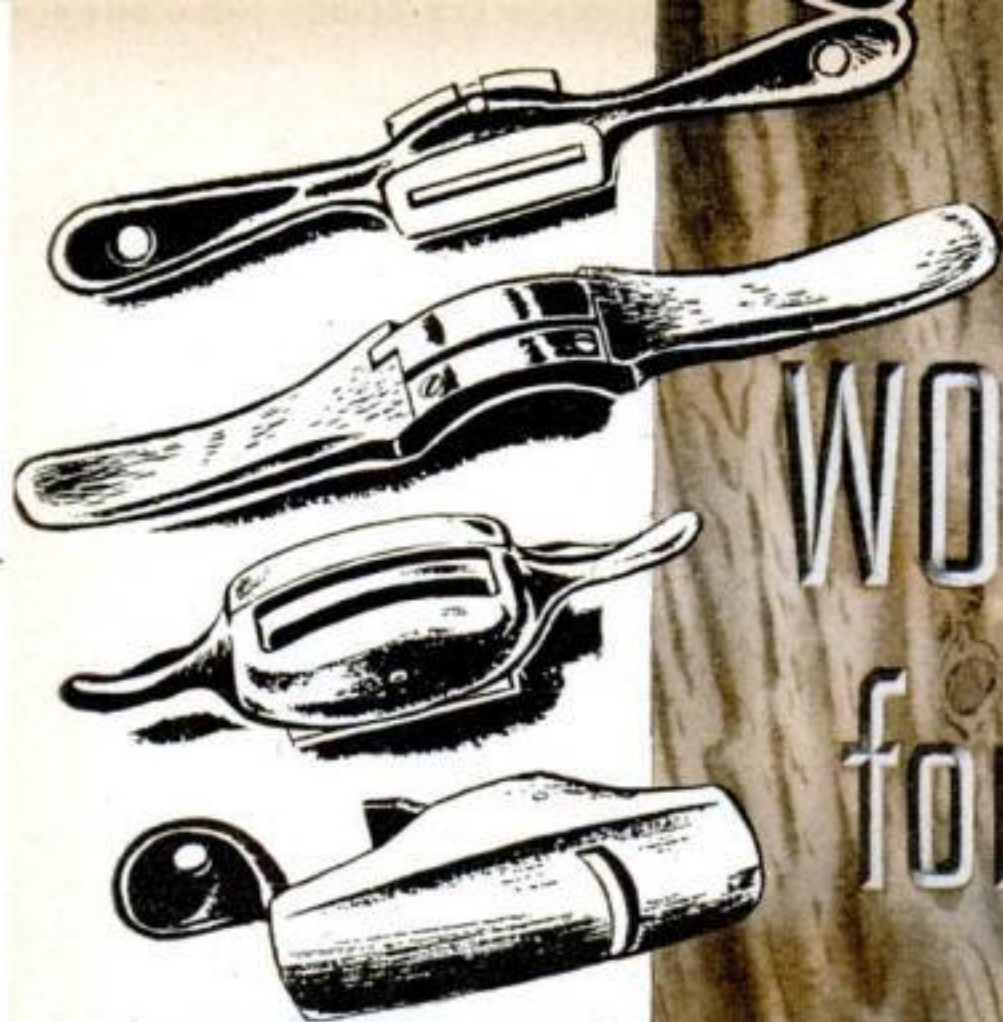
Gridiron Oxygen Tank. Outfitted with 11 masks, the rolling oxygen tank above can reduce fatigue for an entire football team during time-out periods. It was used by Georgetown University during this past season. Tried on backs after long runs, the oxygen was found to restore normal breathing in 30 seconds.



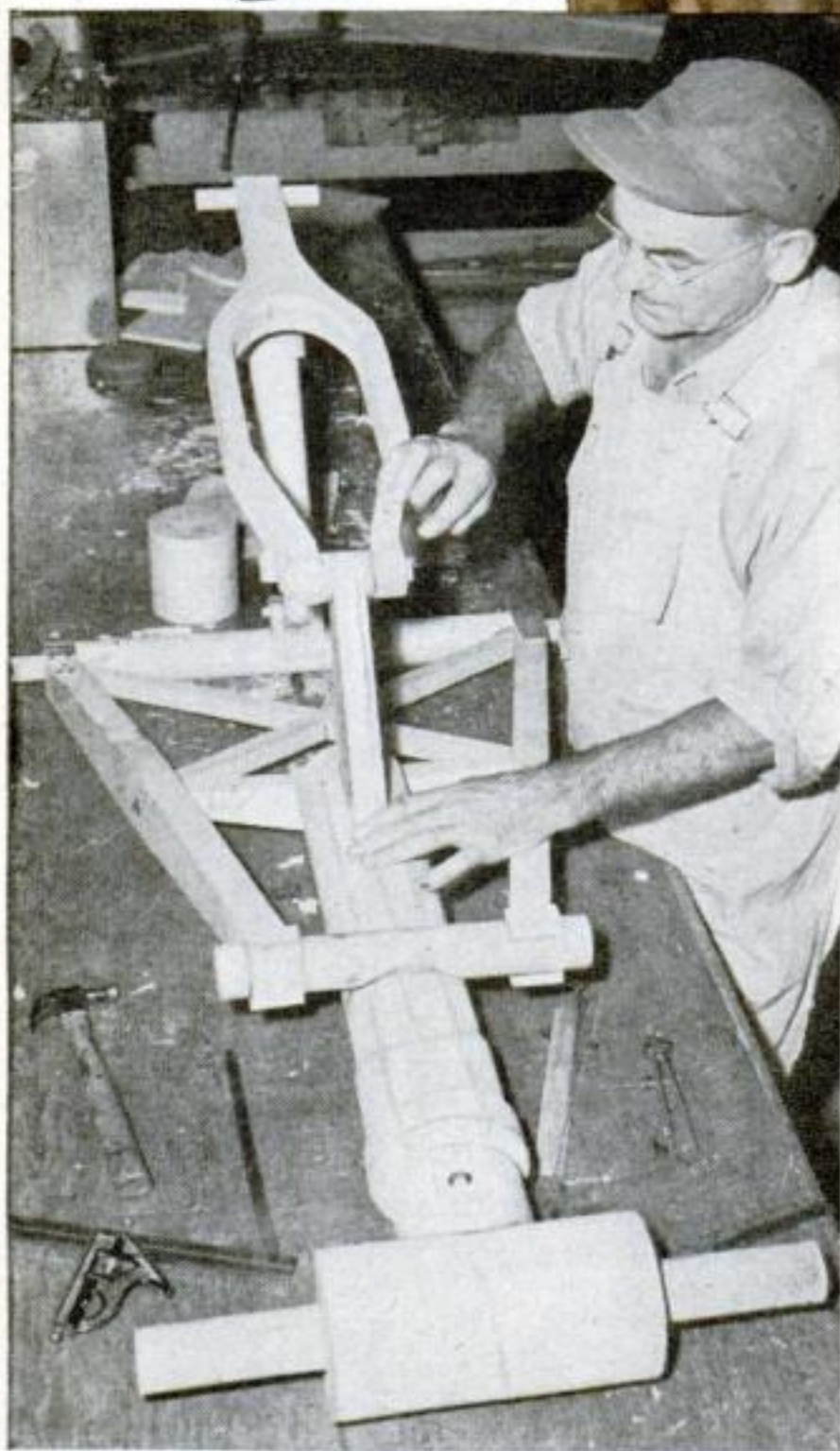
Sidehill Gouger. That mythical animal comes to mechanical life in a new tractor built by L. C. Burton, of Akron. Its wheels automatically adjust to grades as steep as a drop of two feet in three. To do this, two differentials are housed one within another; the first to drive the rear wheels, the second to level the tractor.

Fuselage Fueler. The shortage of building materials didn't faze Byron Chedester and J. E. Franks, of Fort Worth, Tex., when they wanted to go into the gasoline service station business. They simply bought the body of a Conestoga plane—engine and instruments removed—and opened up. The plane cost the pair \$500; the moving, \$100.





WOOD CARVERS for the AIR AGE



Thirty-five pine and plywood parts, with tolerances of $1/10,000$ inch, went into this model of a nose-wheel strut for a secret plane. The woodworker is Fred Molle, Northrop veteran. At top of page are four of an aviation carpenter's most important tools. From top to bottom, they are: straight-edge and rounded-edge spokeshaves, pattern-maker's spokeshave and round-bottom plane. Last two are used for roughing out work, first two for finishing it.

EVERY plant that builds airplanes, from the tiniest single-seater to the mightiest air liner, relies on a small group of skilled carpenters to translate engineering drawings into three-dimensional reality. Artisans in wood, they play an increasingly important role in an air age that depends on metal for its advancement.

When designers complete blueprints for a new plane, they turn to these carpenters for faithful models of its intricate parts and assemblies. And the woodworkers, blending shop trigonometry, imagination and the skill of their trade, create the forms and patterns from which metal parts of the plane are later made. With chisel and spokeshave they fashion air ducts, landing gear units, valves, airfoil shapes, engine accessories and scores of other parts.

Some of their work can be rough, but other models and dies contain up to three dozen parts and must be built to tolerances as close as $1/10,000$ inch. Since different jobs require different materials, the woodworkers have to know whether to use maple, pine, birch, walnut, mahogany or the versatile plywood, or combinations of them, for a specific task.

Most of the woodworkers are young men, able to adapt their skill to the rapidly advancing art of plane design. The pictures on this and the following three pages show how well that skill is applied.



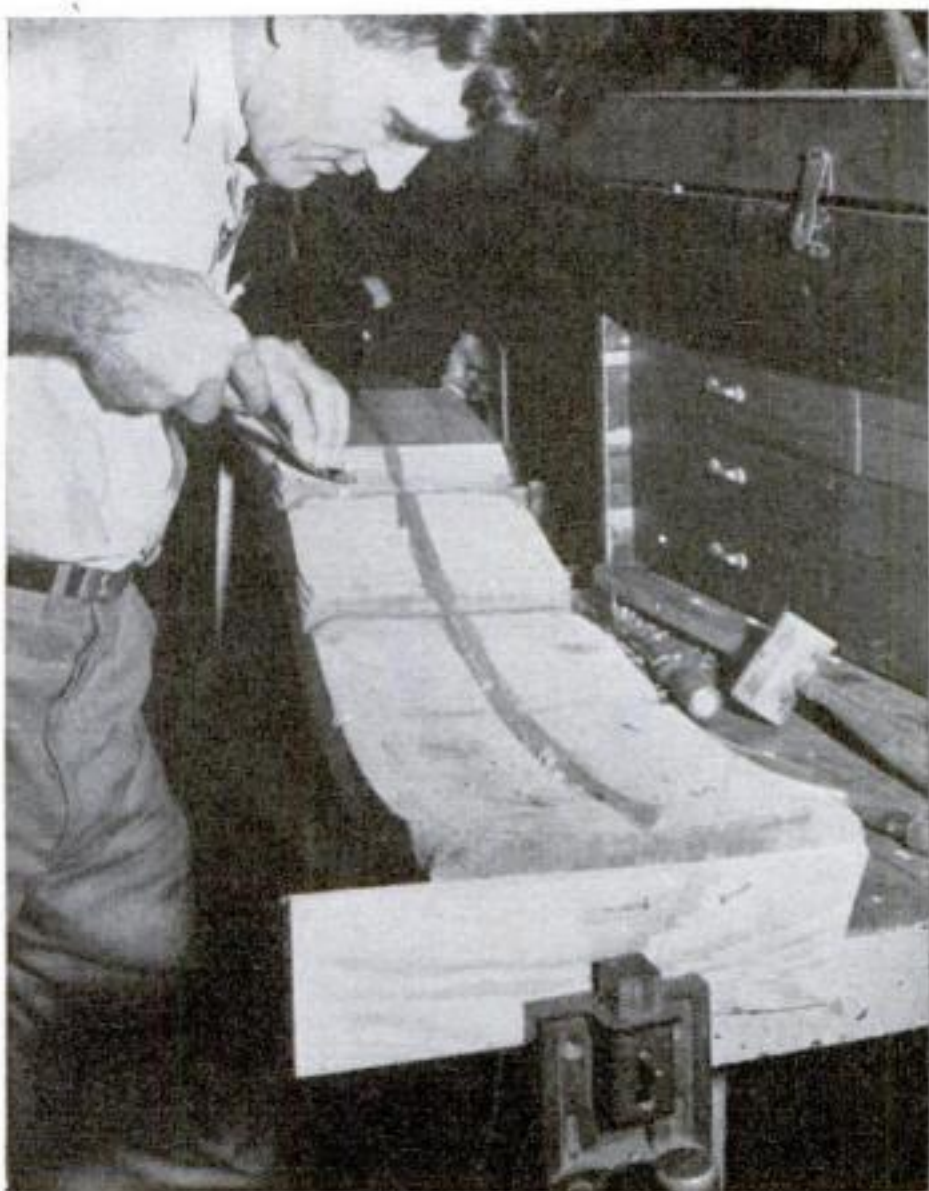
Running a band saw along lines photographed on an emulsified panel of plywood, Harvey Boston, of Douglas, shapes a lofting section, used in establishing a plane's contours. Plywood is sealed and painted before the emulsion is applied.

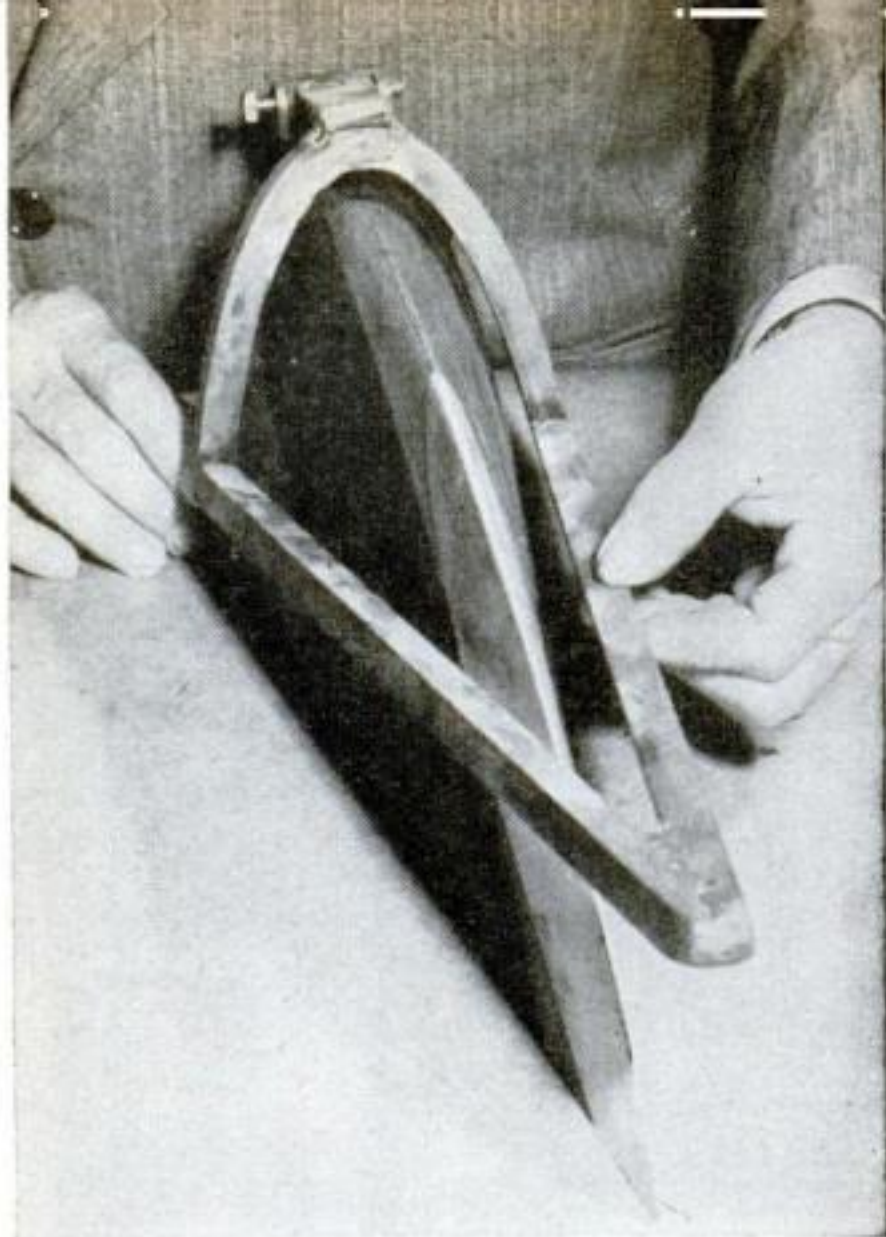
Ted Weimer, of Douglas, fairing a skeletoned check jig to its mold lines with a straight-edge glass spline to eliminate any bumps or hollows. The finished part carries air to a carburetor.



Pattern-maker's spoon, a development of the carving chisel, is used by Sid Gladwell in cutting out a line on the mahogany pattern of a carburetor intake duct designed for the Lockheed Saturn.

Gladwell checks a mahogany model of large air duct with metal template to insure accuracy. Mahogany holds its shape well, with little shrinkage, and is easier to work than pine despite its toughness.





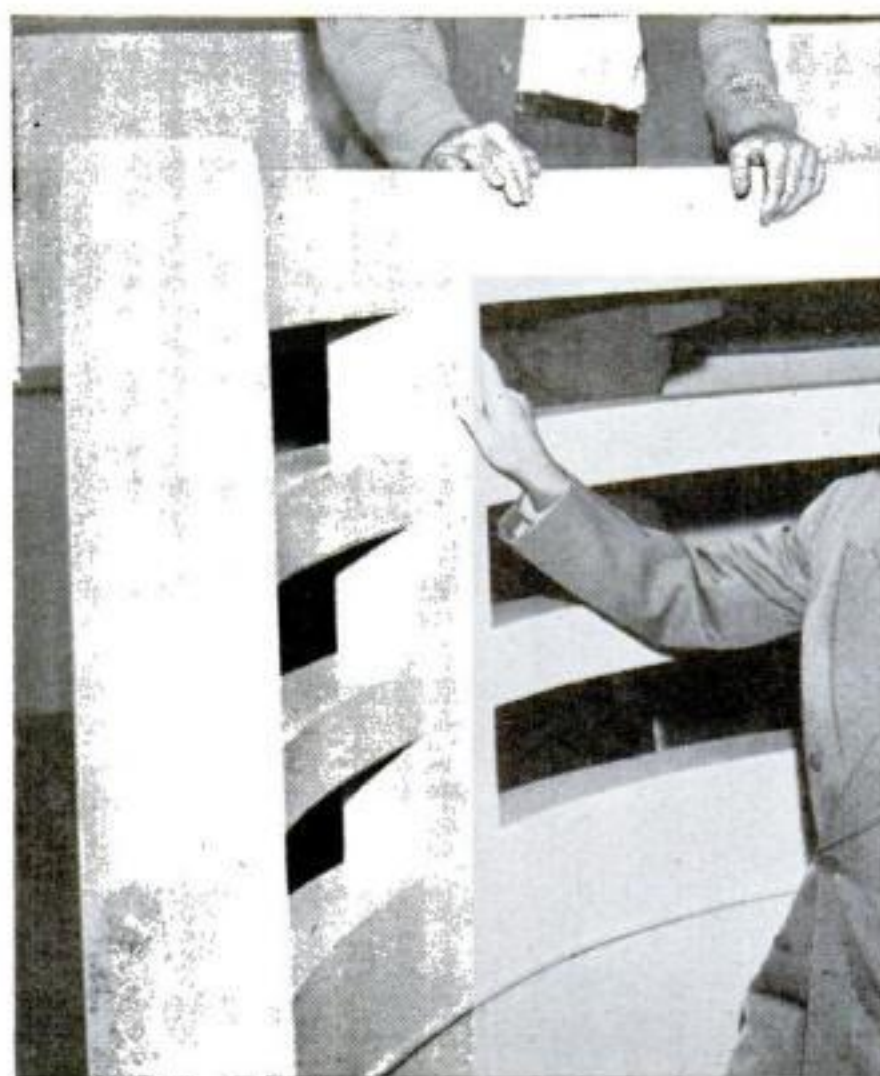
Wooden forming die and metal gate, tipped with aluminum, is used to form plastic wing tip of a small plane. The wood part is made of birch, which has largely replaced maple in aviation woodworking.

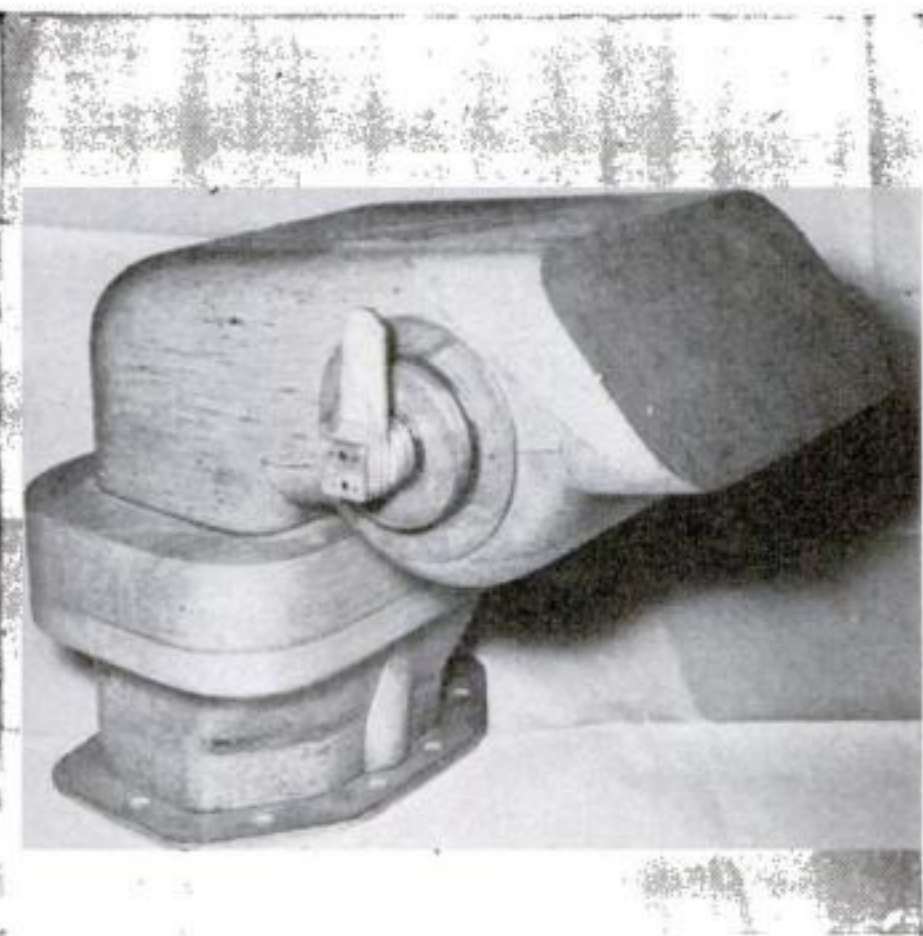


Art Russo, of Northrop, wields a fine-toothed rasp to smooth white-pine tail section of a droppable gas tank. The maple cone at right is a copy of the nose of an air-duct diffuser.

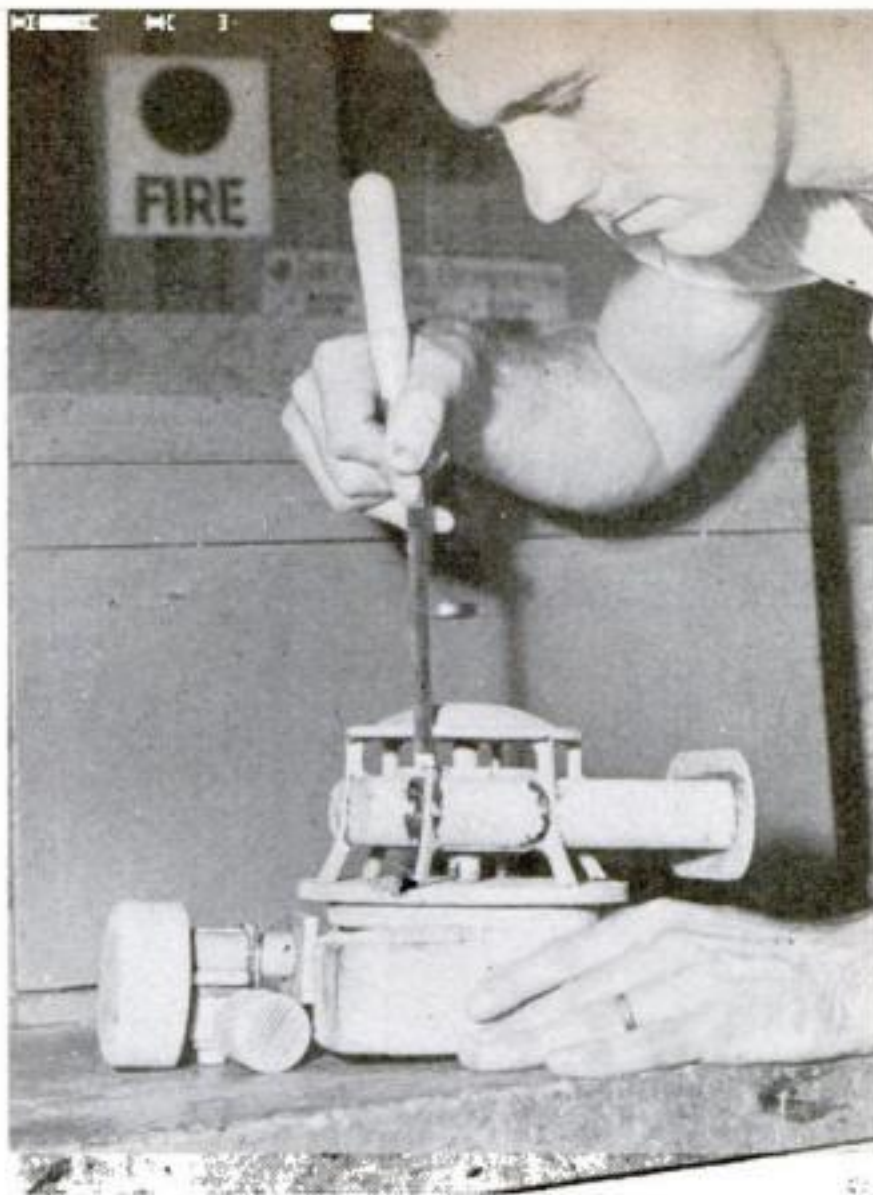


Newest lightweight plywood has mahogany surfaces and a plastic honeycomb core, called micarta. At left, a hand-guided electric router cuts channel through a panel of the material, which is used to form such models as the stairwell and bannister, below, of Lockheed's huge Constitution. The mahogany surface of the new plywood provides an extremely smooth finish that takes lacquer well.





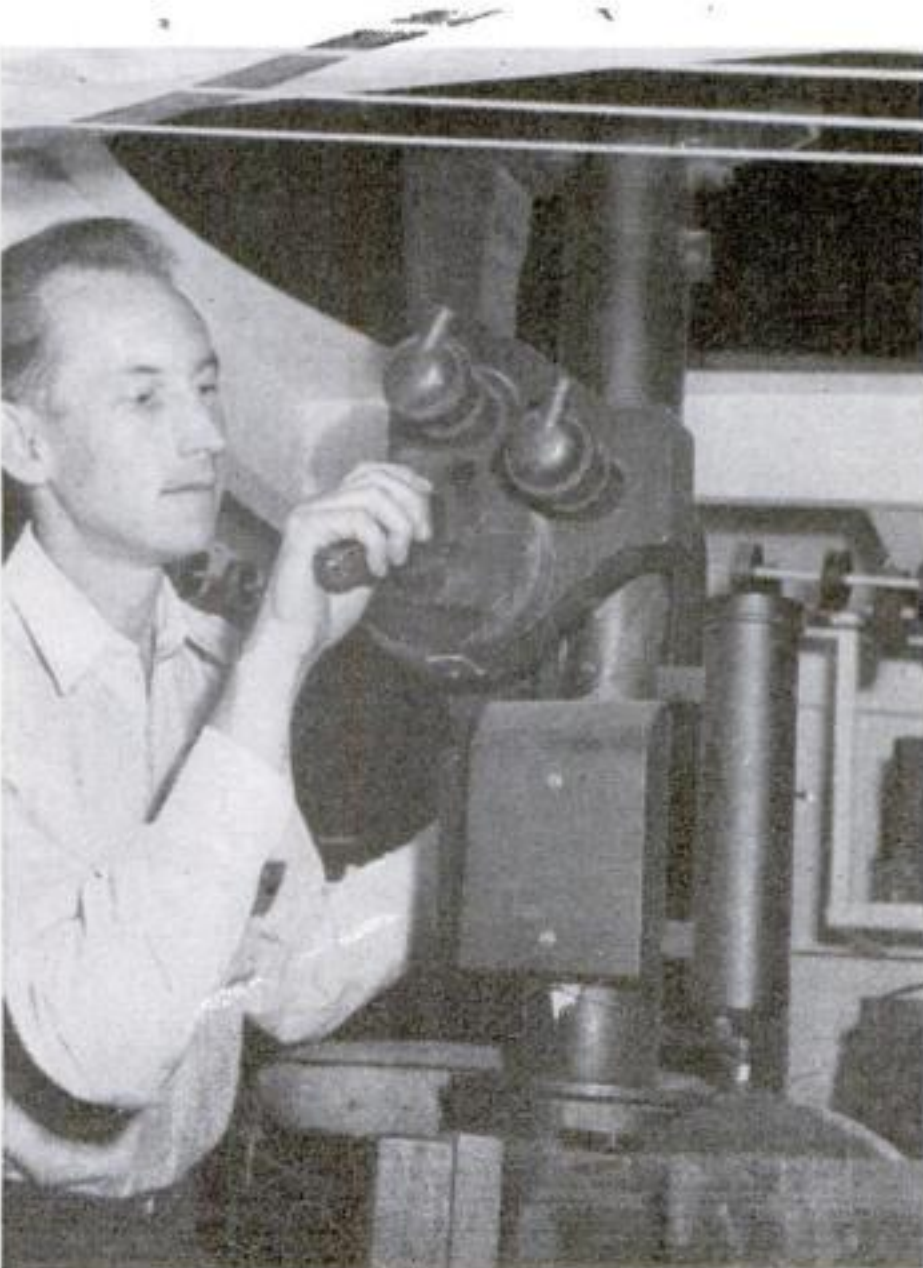
A dozen pieces of sugar pine were put together with waterproof glue to form this model of the Lockheed Saturn's carburetor intake valve. Engineers use the model in making clearance studies of accessories.



Using a $\frac{1}{2}$ -inch bent-shank carving chisel, Northrop's Stanley Ton smooths plywood bracket on a reproduction of oxygen pressure regulator. Other parts of the complex assembly are made of white pine.

Lynn Covington, of Northrop, makes a final check of wooden gunsight model being prepared for a bomber. Painted black to resemble its metal counterpart, the model enables designers to plan working layout before final assembly of the airplane.

Covington fits precision-made wood assemblies into a prototype airplane's radio compartment. By thus simplifying details of arrangement, the aviation woodworkers' creations save time, money and effort—and assure greater efficiency in new planes.



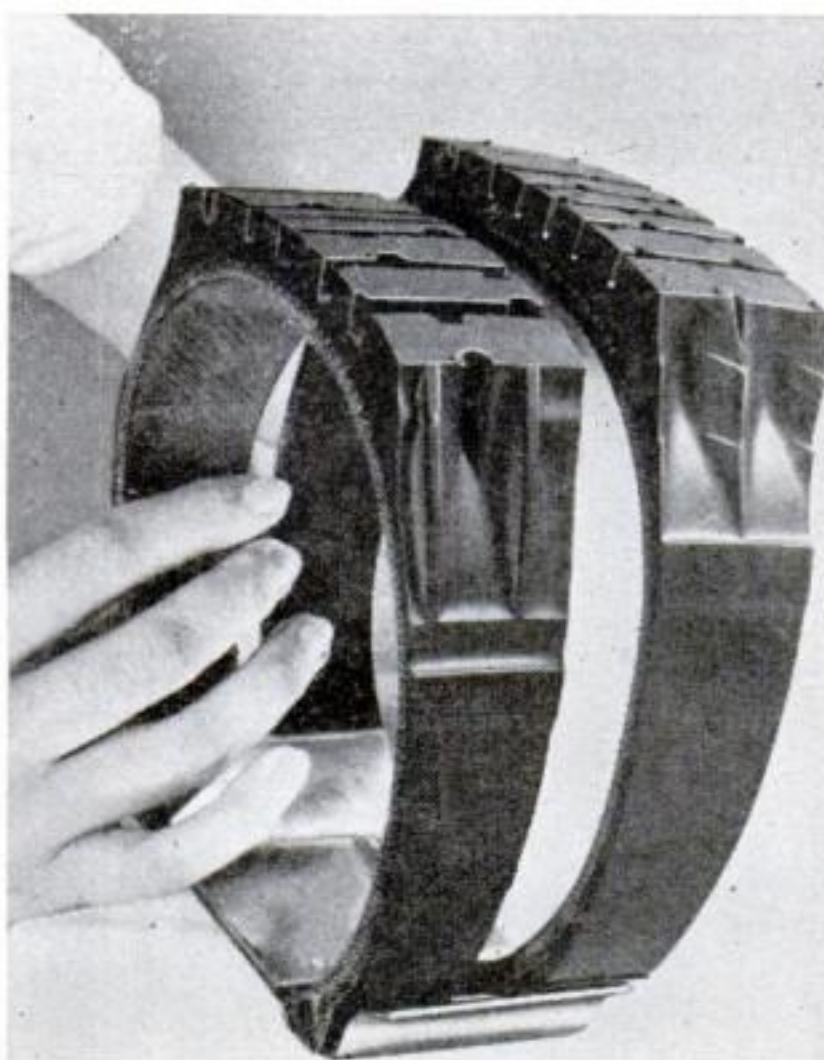


Roadless Road Test. To test new gasolines, Gulf Oil Corp. has installed a "highway" in its Harmarville, Pa., laboratory. The front wheels of the car are chocked on a road-test dynamometer. The rear

wheels rotate a heavy drum, retarded by machinery to simulate the effects of car-loading and road conditions. Uphill pulls are created by braking the drum; down grades, by cutting in an electric motor that helps rotate it. A fan blows wind at the car at its assumed speed. The "driver" calls off mileage. Man in back seat records findings. Elimination of variable factors found in real road tests increases accuracy.



Slow-Leak Tube. For greater safety, the U. S. Rubber Co. has designed a new inner tube (above) that curbs rapid deflation in case of a puncture. The tube's secret lies in a wafflelike crown whose square pockets contain extra butyl rubber. When the tube is punctured, this rubber presses around the piercing object.



Air-Bubble Tire. Lighter and tougher is the new air-bubble tire produced by the U. S. Rubber Co. Designed for 14 percent more air volume and eight percent lower pressure, its flatter tread and sharply defined shoulders use less rubber—sharply cutting road heating. A section of the new casing is shown at right above; at left, the old.



Inside the Dreamboat

More planning than flying went into the Army's long hop over the top of the world.

At 5:51 a.m., local time, on October 4 the Boeing Superfortress "Pacusan Dreamboat," under command of Col. Clarence S. (Bill) Irvine of the Army Air Forces, took off from the island of Oahu, Hawaii, for a flight over the top of the world. Less than 40 hours and 9,422 statute miles later it touched down at Cairo, Egypt.

The Dreamboat had proved that routing tomorrow's air traffic across the Arctic—using the shortest distances between most points on the habitable parts of the globe—was practicable. Nor was the flight without military significance. "He who rules Alaska," said the Air Corps' immortal Billy Mitchell, "rules the world."

Here is the inside story of the Dreamboat's flight as told to Popular Science Monthly's Devon Francis by five members of its 10-man crew.



Col. Clarence S. Irvine, of St. Paul, Nebr., pilot: We knew our approximate take-off time. It had to be between 5:30 and 6:30 in the morning. That was because we had to leave the ground *with* the prevailing wind instead of

upwind, and the lowest velocities occurred at that time of day. If we took off upwind, we would pass right over the city of Honolulu,

PSM FEATURE
EXCLUSIVE

with mountains in front of us. We couldn't take that chance, heavily loaded as we were.



Richard B. Snodgrass, of Seattle, a civilian and chief engineer: The weight of the airplane at the start of the flight was approximately 148,500 pounds. That's about five tons more than the Superfortresses grossed during the war when they took off to bomb Japan.

Colonel Irvine? But we weren't worried. We had planned this flight for too long a time, and we knew exactly what we were to do in any contingency. By building a piece of runway 100 feet long, we had linked up the Navy's John Rodgers Field and the Army's adjoining Hickam Field. That gave us about 13,000 feet in which to get off the ground. I had posted markers along the runway at each 2,000-foot mark up to 12,000 feet to judge distance at high speed. The markers were check points. We had to be sure of where we would get airborne.

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Lt. Col. Beverly H. Warren, of Plainview, Tex., and Omaha, Nebr., co-pilot: Our minimum calculation at the start was that we would be airborne at 5,600 feet. That took into account the weight of the air-

plane, the rolling friction on the asphalt runway, and the drag against our thrust horsepower available. We figured we could do that if we held the brakes, ran the engines up to full power, and then released the brakes.

But when we tried it in practice flights the propeller torque threw us off directionally just as we started rolling. It was impossible to get the airplane pointed down the runway again without using brakes. That cost us speed. So we decided to start right out from zero and use the throttles to maintain direction. We figured that would cost us another 1,000 feet of runway. We added 1,000 feet to that for the human element, and arrived at the conclusion that we would be off the ground in 7,500 feet.

Colonel Irvine: We knew that we could lose an engine on take-off at the 6,000-foot mark on the runway at an indicated airspeed of 145 m.p.h. and still get airborne on three engines at what we estimated would be 155 m.p.h. If we lost an engine on take-off the procedure called for gaining some altitude, dumping gasoline from tanks in the bomb bay, burning more gasoline for an hour, and coming back to land approximately 25,000 pounds lighter than we were at take-off.

If we lost an engine under the 6,000-foot mark, we could come to a stop before reaching the end of the runway, and without using the brakes, by reversing the pitch of the propellers. I had reversible propellers installed for just that reason.

Colonel Warren: We sat there at the end of the runway with the engines ticking over. I had run them up, and we were squared away for the take-off, facing the length of runway No. 26. I turned around and said to the crew, "Here we go!" Then I opened the throttles.

We had a four-mile wind on our tail. The flaps were down 25 degrees, which is normal. The airplane felt good as we gained speed. We had the trim set exactly where it should be for fore-and-aft balance. That, I must say, was accidental. It's hard to figure trim. It

was a very short time until we had full power on. That was 2,800 revolutions on the engines with 52½ inches of manifold pressure.

It was at about 2,000 feet of our run, maybe 2,500, that the least back pressure on the control wheel brought the nose wheel up just enough to clear the runway. I just held it there until the airplane flew itself off. It came off smoothly and cleanly. I don't think anyone in the plane actually knew the instant when we left the ground. Our indicated airspeed was 148 m.p.h. We had consumed 6,500 feet of runway. The controls felt firm, not soft.

As we lifted off I turned to Colonel Irvine and said, "Bill, this is no different from a thousand other take-offs we've made together."

He replied, "If you ever had a take-off in your system, this was the time to do it."

We got the landing gear up and pulled up the flaps very slowly, meantime gradually reducing power. We were climbing gently as we rounded the southwest end of Oahu.



Maj. Norman P. Hays, of Seneca, Mo., navigator: We held the take-off heading for a few minutes as the airplane gained speed. The directional gyro was set. It was checked with the astrocompass. We used

dead reckoning from the point of departure to the point of first climb. Then radio-compass fixes were obtained.

Mr. Snodgrass: We pulled 1,450 horsepower from each engine at the start of the flight, once we were leveled off. That was 72.5 percent of rated power.

Colonel Irvine: The flight was going just the way we had planned it. The planning had been the hard part. In attempting a flight over an area where our best information indicated that communications would be undependable and ground-radio aids scarce, and where rescue certainly would be slow in coming if we were forced down, the first requirement was insuring the utmost reliability in the operation of the airplane. This involved two things: first, a thorough training of the crew to get the most out of the plane and its equipment, and exercises in the use of emergency equipment for both water and ice landings; and, second, the en-

gineering preparation. We devoted three months to nothing but engineering calculations.

Mr. Snodgrass: We ran fuel flow-power calibration curves for the engines at 1,000, 5,000, 10,000, and 15,000 feet. Torque meters showed us exactly how much horsepower was being drawn from each engine. At a preset altitude we used a given power setting to get an indicated speed, and calibrated that for every altitude and power setting we expected to use. That, of course, had to be refined by calibrations for various weights. We tested the fuel-flow meters, the air-speed indicators, engine thermocouples, and everything else that would have to be calibrated in flight.

Major Hays: It looked as though navigation would be something of a problem. There were no charts available of the kind I wanted for polar navigation. In fact, there were few polar-navigation charts at all. So I got a stereographic (three-dimensional) map at a scale of 1:5,000,000. Then a grid was constructed and superimposed on the chart. Greenwich was used as grid North reference. The best available lines of magnetic variation were converted to grid variations and plotted on the chart.

We didn't take along any equipment like Loran. It was too heavy. For the same reason we didn't take any navigation tables. We did take an air almanac and a new addenda sheet for correction of low-altitude refraction. The most important item we took was the directional gyro—the magnetic compasses would be useless. Then, of course, we took two sextants for sun and star sights.

Colonel Irvine: We did a lot of things to the airplane. In addition to installing bomb-bay tanks, we replaced two center-section regulation tanks with nylon cells to save weight. We installed a special fuel system. We fixed up the oil reservoirs of the four engines so we could pump oil from a reserve supply in the fuselage to any one of them. But, more important, we could withdraw all the oil from any one engine if we wanted to and use it for the other engines. If an engine went bad, its oil wouldn't be wasted.

We replaced the regular landing-gear retracting system, which brought up the wheels in 30 seconds, with one that brought them up in nine seconds. That was for added safety in take-off because half of the total

drag of a B-29 at speeds under 150 m.p.h. is in the landing gear.

We pumped up the tires to 110 pounds, about half again as much air as they normally carried, and let them stand for a week so they would get a permanent "set." Then we measured them and altered their wells to accommodate the stretch.

By reducing the cowl-flap openings we knew we could pick up a few miles an hour in speed. By repeated flights we discovered we could open the two upper flaps on the inboard engines no more than $1\frac{1}{4}$ inches and those same two on the outboards about an inch and still get sufficient cooling with all side flaps completely closed. The cooling on the inboards was more of a problem, quite naturally, due to fuselage interference with the air flow.



Lt. Col. Frank J. Shannon, Sr., of Philadelphia, communications officer: The Dreamboat was equipped with a low-frequency adapter to cut through ionospheric disturbances if they developed. I had talked with

"fringe" fliers who had been on the edge of the auroral radio disturbances, and they had told me that, in the Arctic, communications simply went out. All of our air-ground communication was to be in International Morse, of course.

We confidently counted on radio blackouts at from 60 to 70 degrees North. The "fringe" fliers said there would be no static; a receiver would just go ahead. The only thing we would hear would be the hiss of the thermal effect of the transformers, of the wiring and filament emission of the vacuum tubes. Low-frequency sending and receiving would cut through, but it would be practicable only at short range.

I was prepared for another phenomenon—ionospheric "skip." That comes from the high-frequency signals hitting the gaseous envelope surrounding the earth and bouncing back beyond the station you're trying to contact.

But I figured we were covered for any kind of a contingency. I over-planned, in fact. Among many other things, I had asked that "hams" all over the country belonging to the American Radio Relay League cover my frequencies. They did—in volume. I got their reports when I got home.

Colonel Irvine: We had adequate safety devices if we were forced down. We took along the standard Air Forces emergency kit containing rations and medicines. To that we added a sea-landing kit, essentially the same one used on flights against the Japs, and an ice-cap kit—carbines, ammunition, a special gasoline cook stove, food for three weeks, three complete sets of sock-lined felt boots for each man, fur parkas and trousers, and gloves. We studied the procedure for survival in the Arctic.

If we were forced down at sea, we would have two seven-man life rafts. In addition, each man would have his own raft attached to his 'chute, his Mae West, fishing tackle, pyrotechnic signals, and equipment to make salt water drinkable. Our safety equipment weighed 120 pounds per man.

It was because we had prepared so carefully that we weren't surprised that everything seemed so routine once we were under way.

Colonel Warren: When we had reached our maximum speed at original cruising power we were indicating 233 m.p.h. That was good. We had figured it would be only 228. For the first five hours or so we held 1,000 feet of altitude. Then we hit a weather front and had to climb to between 5,000 and 6,000 feet. It was soupy there. We climbed slowly, using no additional power. That would have cost us slightly more fuel.

We held that altitude until we were 30 minutes off the coast of Alaska, at Sitka. Then, still not increasing power above that for cruising, we climbed to between 15,000 and 16,000 feet. It got dark just before we hit Sitka. Through a few breaks in the clouds we caught glimpses of lights below. We saw Juneau, too, by luck, but mostly we had to fly in soup.

A weather-reconnaissance plane we talked to assured us we wouldn't pick up ice, but we did. It was rime ice. That's not the dangerous kind, and it did not become serious. We had no de-icing boots on the wing. They would have added weight and drag to the Dreamboat.

Colonel Shannon: Communication was perfect. We were equipped with frequencies of 11,445, 8,200 and 6,355 kilocycles, and we were not out of touch with the Airways Communication System (formerly Army ACS) at any time. We worked WZJ at Hickam Field until we got past Fairbanks. I knew we could

work stations at Seattle, Anchorage, and Fairbanks—or try to—but then came a long break of more than 2,000 miles between Fairbanks and Frobisher Bay, Baffin Island. I assumed we would have trouble there. We didn't.

From Frobisher Bay we had the facilities of a station on the west coast of Greenland known as Blue West 8, another on the southern tip of Greenland known as Blue West 1, and others at Reykjavik, Iceland, and in Europe.

By the time we were breaking out of Alaska and entering the Yukon Territory I was in touch with Blue West 8.

Mr. Snodgrass: Meantime, we were keeping a constant check on the fuel. We used our lift-over-drag ratios and refined them with considerations of propeller efficiency and the most economical fuel consumption we could reach. The consumption at the start of the flight had been 436 gallons an hour. That dropped steadily.

Major Hays: We had to use dead reckoning when the airplane was between layers of clouds or in the soup. We had anticipated a nine-knot tail wind. The forecast winds were very accurate over the Arctic, and we checked them with celestial fixes when we could. These winds held good until we approached Greenland. Then we hit head winds where tail winds were forecast.

Colonel Irvine: It was plenty cold. But we encountered the arctic temperature moderation at altitudes that I had anticipated. Our outside temperature at 20,000 never went lower than minus 36 degrees Centigrade. But that drives you to bundling up—and then you sit there and shiver. A B-29 isn't insulated.

Colonel Warren: We were in intermittent soup for about 1,000 miles inland. We picked up more rime ice. The amount of it never reached the danger point, though. Pretty soon the clouds began breaking up around us. We found ourselves over a low undercast. There were times when the undercast was broken and even scattered.

We could see mountains and lakes in the moonlight. It looked like pretty rugged country. You didn't want any part of it.

Just before sunup we approached Baffin Island. On its westward side and in the interior it looked as though it had been shaved off by a glacier. There wasn't nearly as much

snow as we had expected to see. There was plenty of snow, but we also could see bare patches of ground. As we passed the center of the island and got over the eastern part, the ground got tortuous in contour. On the east coast there were numerous big rivers, deep and not frozen over. There were convoys of icebergs in them.

Colonel Irvine took a look and said, "Here's where we sit back and listen to the sound of the engines."

We had some fun about then. I was sitting in the pilot's seat. We had noticed a few light spots on the horizon, and supposed they were due to the Northern Lights. We had watched the Northern Lights during the night. They weren't very brilliant, nor did they have any color in them. One light spot appeared about 20 degrees left of the nose of the airplane, now. It seemed to grow lighter. If that proved to be the sun, we would be off our course. The sun had to come up to the right of our nose.

I started kidding Norman Hays. Nobody was worried. He's an excellent navigator. Moreover, he had had chances to get celestial fixes. But he got somewhat concerned himself. It took a long time for the sun to appear. We couldn't see it yet but we could see its reflections on clouds. Finally it showed up—at five degrees to the right of the nose, where it was supposed to be. The first rays of dawn came on the wrong side of the airplane due to the rotation of the earth and the high latitude.

Colonel Irvine: Sunrise in the Arctic is the most spectacular thing I have ever seen. Just before the sun cleared the horizon it was suddenly shaded by a greenish cast. It must have been a prismatic effect of ice particles.

Colonel Warren: For about an hour after we hit the coast of Greenland we could see the ice cap. From altitude it looks like water. It has a characteristic wave formation. Here and there are cracks and crevasses, but on the whole it's flat and smooth except for the waves.

We passed a couple of hundred miles north of where the magnetic pole is plotted, and the compass needle still swung back and forth in a northerly direction. It swung the whole time we were in the Arctic, as much as 30 degrees off course.

Colonel Shannon: Over Iceland we picked up another weather-reconnaissance plane. I

asked him what his conditions were and whether there was any icing. He gave me a report and told us not to reduce altitude. We were flying at 20,000, and I relayed that information to the airplane commander.

The weather plane's call was WX-2. That puzzled me because those were the same as the call letters on the weather recon plane that had contacted us out of Sitka. I said to him, "Hey, I thought you were on the ground. Are you airborne?"

He said, "Yes."

I said, "The last time I worked you, you were landing at Whitehorse (Yukon Territory)."

He replied, "I'm a weather-reconnaissance plane out of the 35th Reconnaissance Squadron."

I said, "Where is that?"

But he wouldn't go beyond saying, "Our headquarters is in Newfoundland."

I called Colonel Irvine and said, "Hey, we've got a weather recon plane."

Colonel Irvine replied, "Let's get on him." So as soon as we could we changed to voice, 4,220 kc., and the weather plane and Colonel Irvine talked back and forth.

Colonel Warren: The soup began breaking up about 300 miles from England. The sun went down. We caught a glimpse of Prestwick, Scotland, and some other towns. Then the undercast became solid. We missed a sight of London and Paris entirely. London told us its Northolt radar station had identified us, but we never did make contact with a British bomber that was supposed to come up and meet us.

We swung about 50 miles south of our course in crossing the Alps, in response to a warning from the Paris radio that thunderstorms were building up ahead of us. We saw none.

Mr. Snodgrass: Just after we cleared the Alps we shut off No. 4 engine and feathered the propeller. That was because we needed so little horsepower—the airplane had become so light—and I couldn't get the total power output down by throttling back. We were pulling only 740 horsepower each from the three remaining engines. That was a special condition with this B-29, of course. We were stripped down and very clean.

Our speed toward the end of the flight was only 174 m.p.h. The drop in speed had to do with the most economical power settings for the weight of the airplane. We could go far-

ther at the reduced speed for our weight. Our fuel consumption at the end was only 156 gallons an hour. Our gross weight was 73,088 pounds when we reached Cairo. All that reduction, of course, was not due to fuel consumption. The engines each used about 38 gallons of oil on the flight.

Colonel Irvine: The worst weather of the trip was still ahead of us after we left the heel of Italy. Over the Mediterranean we ran into thunderstorms, icing conditions—clear ice, too, the dangerous kind—and even a fancy display of St. Elmo's fire. We were all over the sky from the turbulence. Then, suddenly, the weather cleared. All around us were fleecy clouds. Pretty soon the sun came up.

The landing at John Payne Field in Cairo was routine. The Dreamboat tilted her nose

and put her heels on the ground like a lady. With the head winds we had encountered, we figured we would have 500 gallons of fuel left in the tanks. Actually we had 414.

I'll take the Arctic. It's navigable. Communication can be maintained.

Major Hays: Except for what it does to a magnetic compass, arctic flying is just like flying over Missouri.

Colonel Irvine: The Dreamboat stood the trip all right, too. When we got on the ground I asked Master Sgt. G. S. Fish—he's the engineer attached to the Dreamboat and he really owns the airplane, you see—to check up on both airplane and engines.

Pretty soon he came back and reported. "Boss," he said, "all she needs is some gas and oil, and she's ready to go." **END**



Members of the Dreamboat's crew at Cairo after completing their over-the-top flight: Left to right (standing), Col. C. S. Irvine, flight commander; Lt. Col. B. H. Warren, co-pilot; Majs. N. P. Hays and J. T. Brothers, navigators; Maj. J. R. Dale and R. B. Snodgrass, flight engineers; (kneeling) Lt. Col. F. J. Shannon and M/Sgt. E. G. Vasse, radio operators; Maj. J. R. Kerr and M/Sgt. G. S. Fish, aircraft engineers.



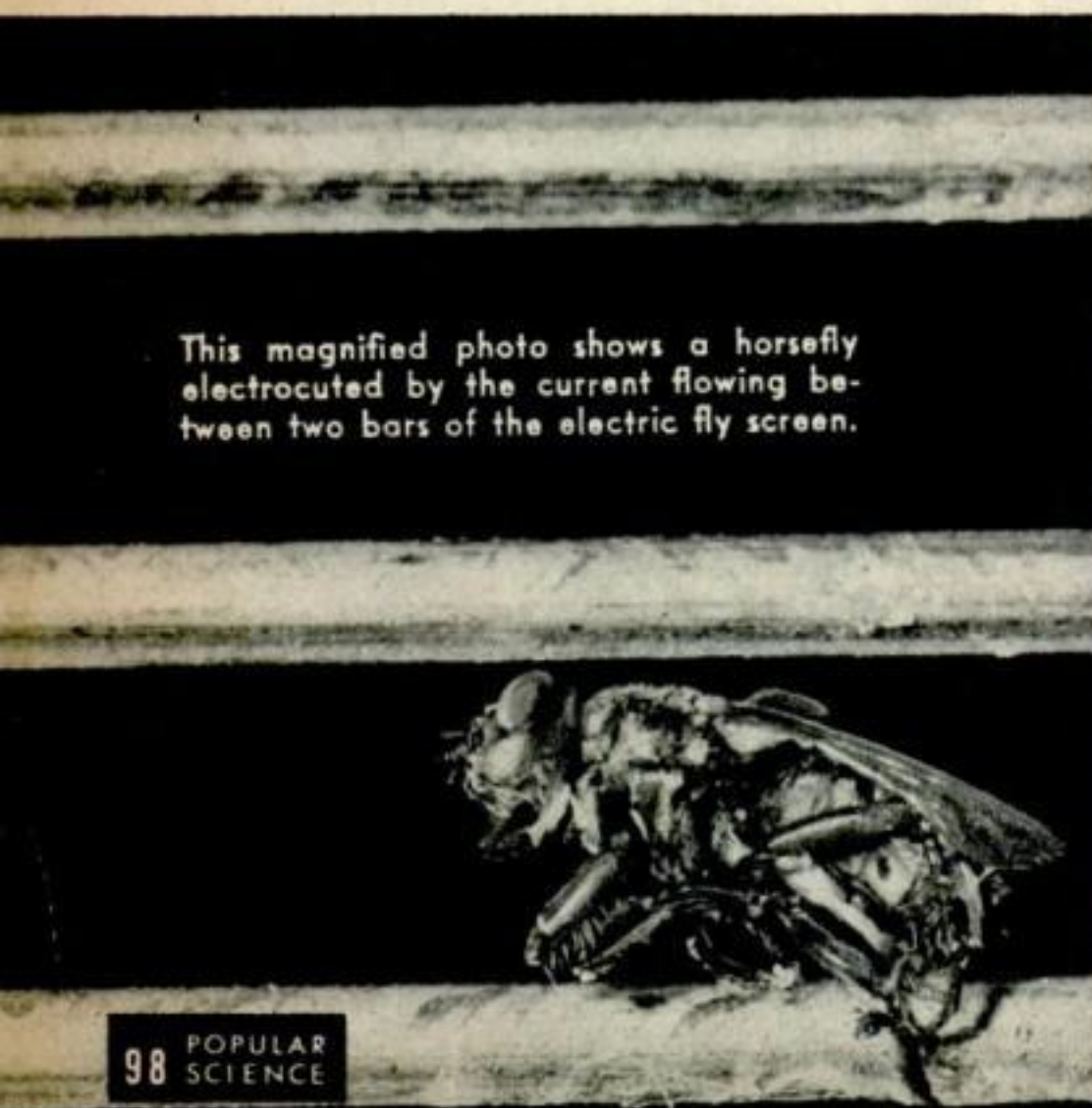
LOCKHEED SATURN. Designed to serve small towns with limited airport facilities, this twin-engine transport uses exhausts for more power and a laminar-flow wing for more speed; takes off with a 1,500-foot run. It needs no special servicing devices, and both passengers and cargo can be taken aboard without ramps.



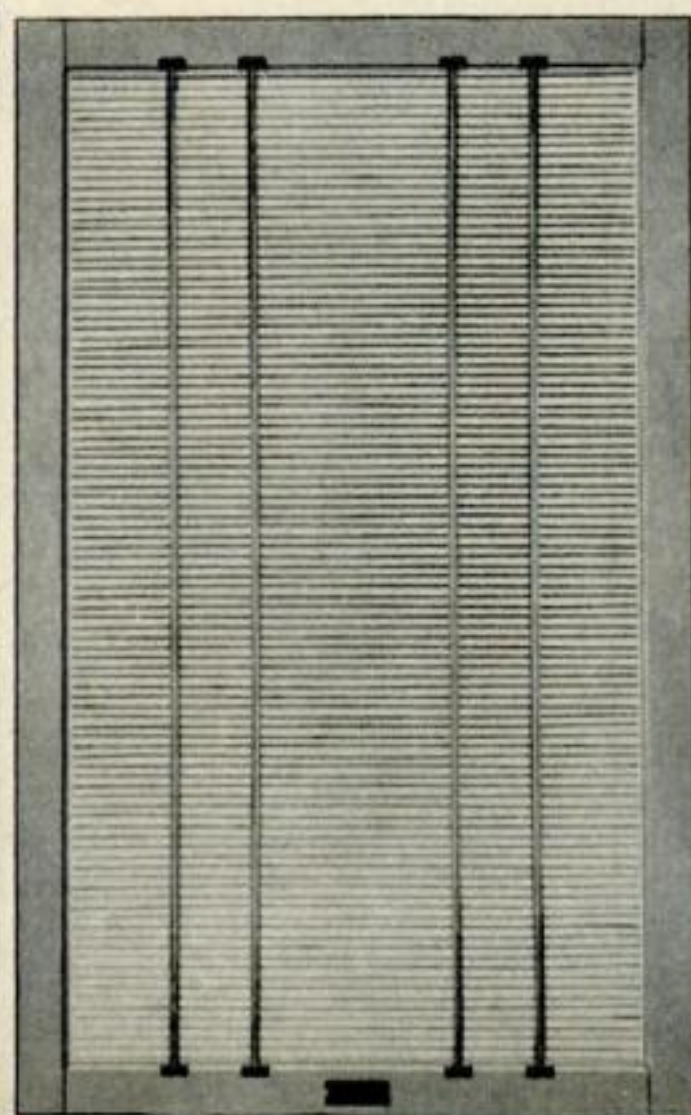


Britain Mass-Produces Homes. Cranwell House (inset) is one of England's answers to the problem of 4,500,000 homes leveled or damaged by Nazi bombs. Cranwell is a two-home unit that costs \$13,000 and takes three weeks to build. It is built of 3-foot-by-9-inch hollow fire-clay blocks, shown above, at right. Since these are simply dropped into place and locked together, unskilled labor can be largely used.

Electric Fly Killer. Fatal to flies and harmless to man, the electric screen shown below, at right, consists of horizontal bars spaced $\frac{3}{8}$ inch apart, with every other bar positively charged by one pair of vertical struts. The alternate bars are negatively charged by the other pair of struts. Moisture from an insect's body closes the 10-milli-ampere circuit from one bar to another. The screen is produced by the Detjen Corp.



This magnified photo shows a housefly electrocuted by the current flowing between two bars of the electric fly screen.



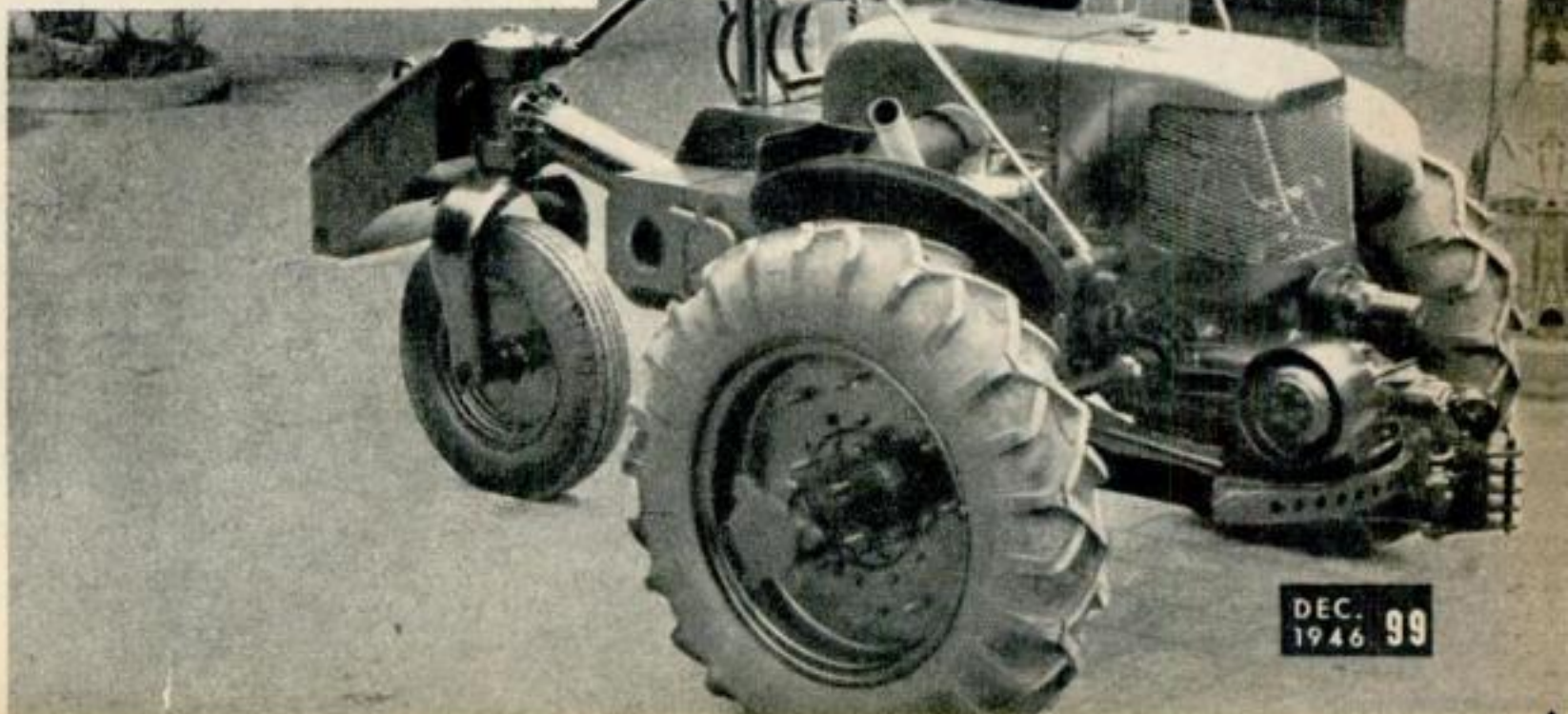


Radio Pulls a Plow. The British have borrowed from their Queen Bee radio-controlled aircraft to build a Queen Bee experimental farm tractor with remote control. The machine's controls are operated by motors powered by compressed air, which in turn are controlled by electrical relays actuated by radio signals. A demonstrator is shown above directing the tractor with a hand control box. The Queen Bee makes turns and plows a straight furrow. The fortunate farmer of the future will be able to sit at ease out of



the weather and direct as many as six such robots staggered one behind another. The tractor is still in test stage.

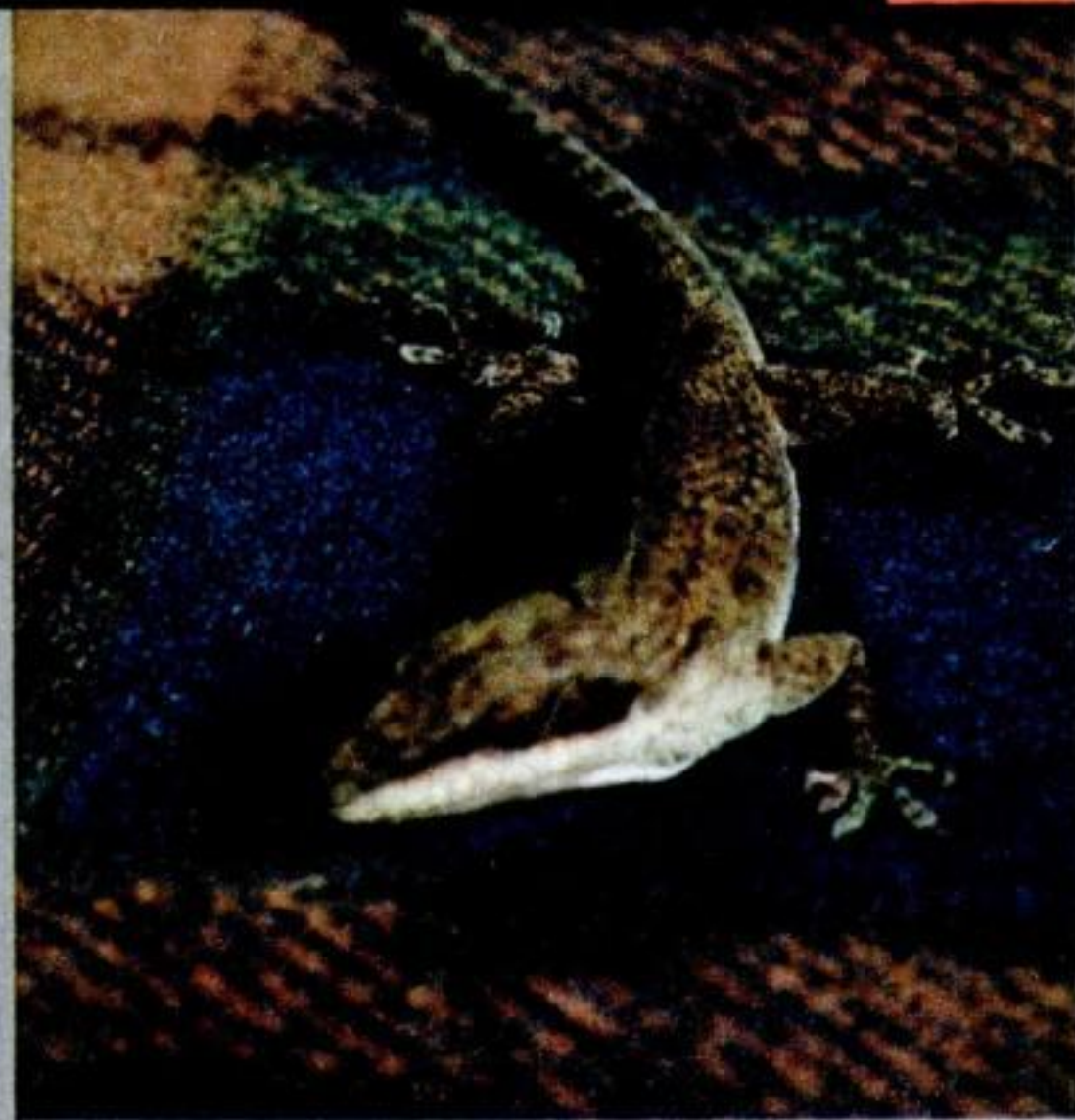
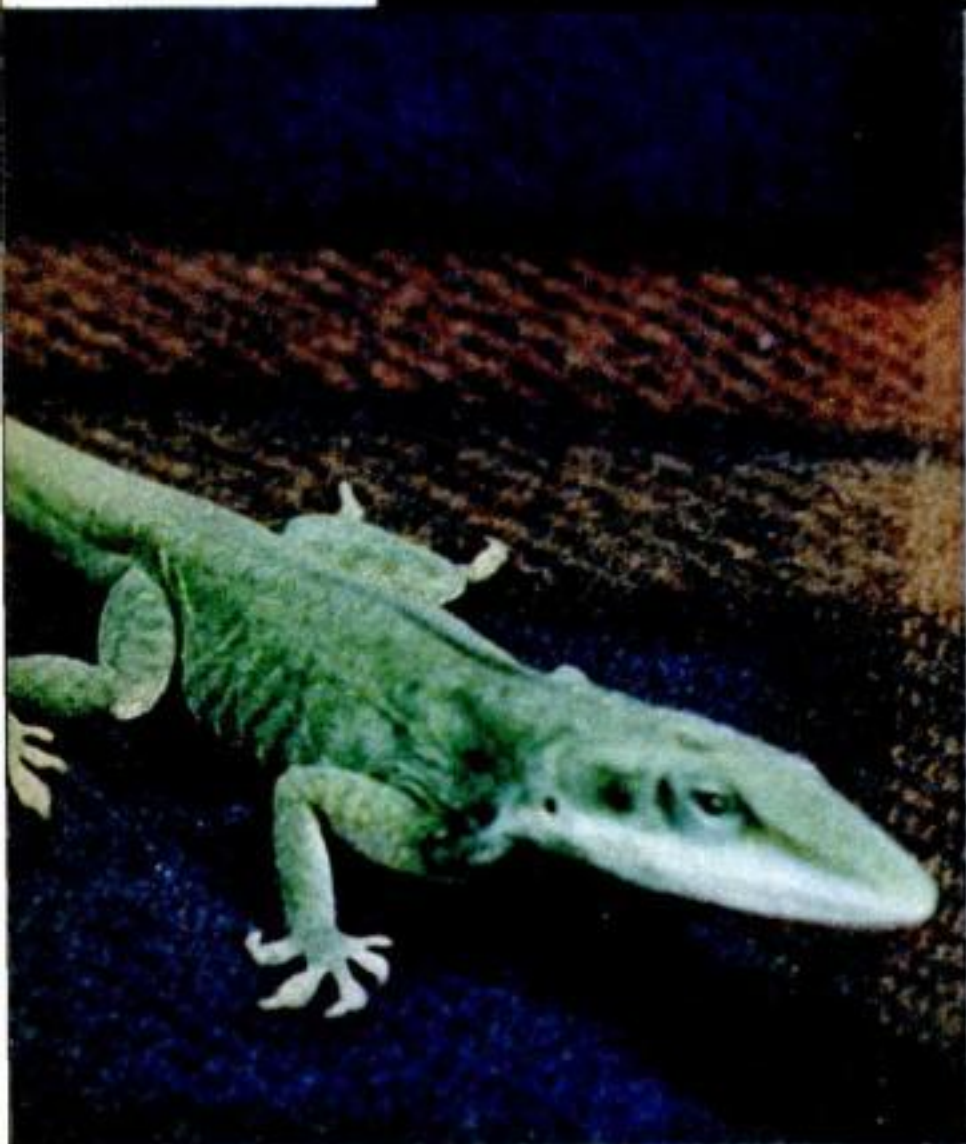
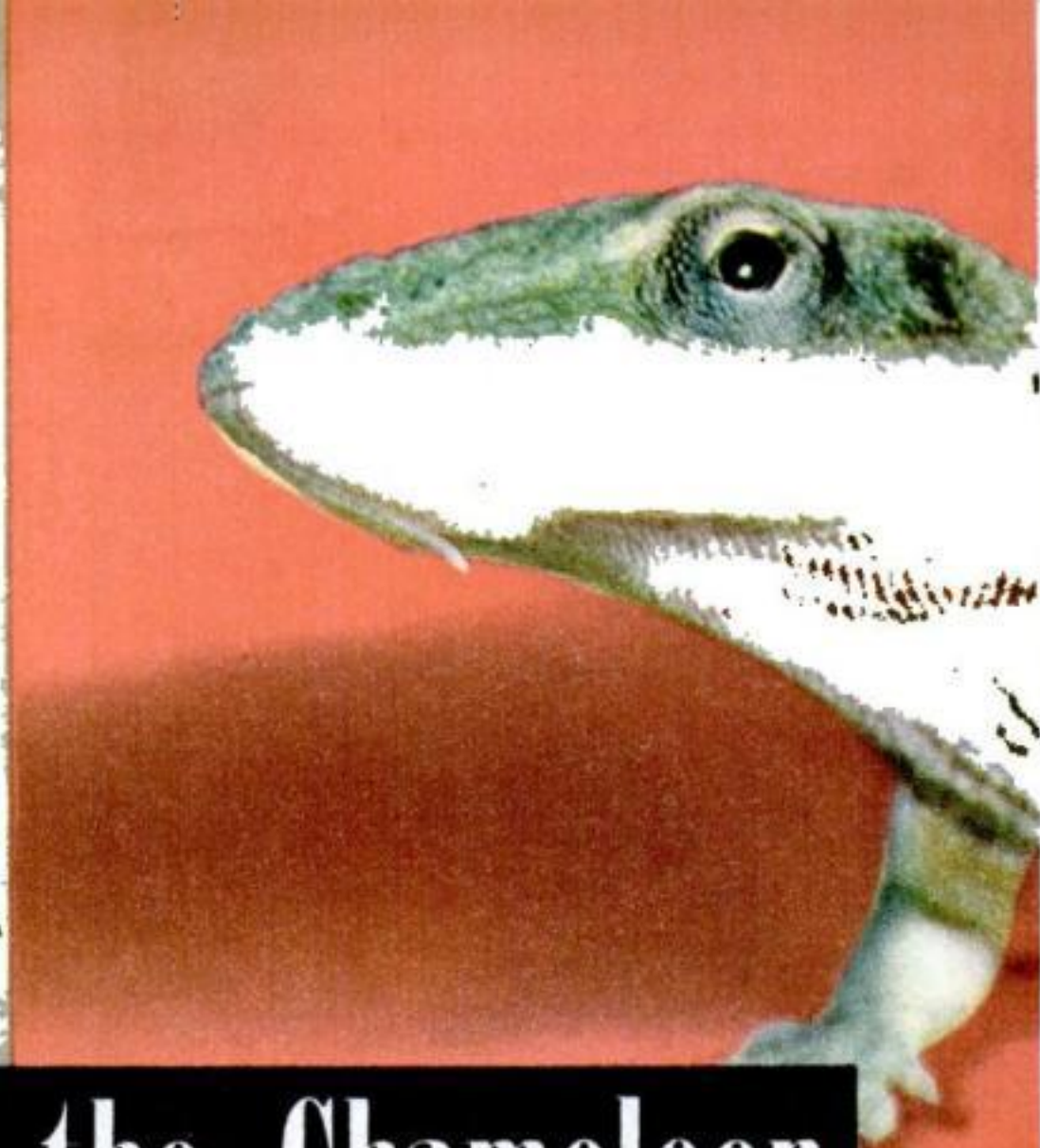
New French Farm Hand. The tractor below is a postwar product of the Societe Nationale de Constructions Aeronautiques of France. The machine has five speeds forward and laterally adjustable wheels in the rear. It is now being tested on French farms preparatory to going into full production.



It's pure myth that a chameleon has the innate power to change its color to match its background. The popular fallacy springs from the fact that the sub-lizard does change its hue from time to time. But this change has nothing to do with the color upon which a chameleon is placed. It is involuntary; there's nothing the chameleon can do about it. The forces that dictate its color are variations in light, temperature and the way it feels. In the pictures on these pages an American chameleon of the genus *Anolis* is given ample chance to exhibit its color prowess, but it falls down in every instance. At right, the reptile stays green on a red background.

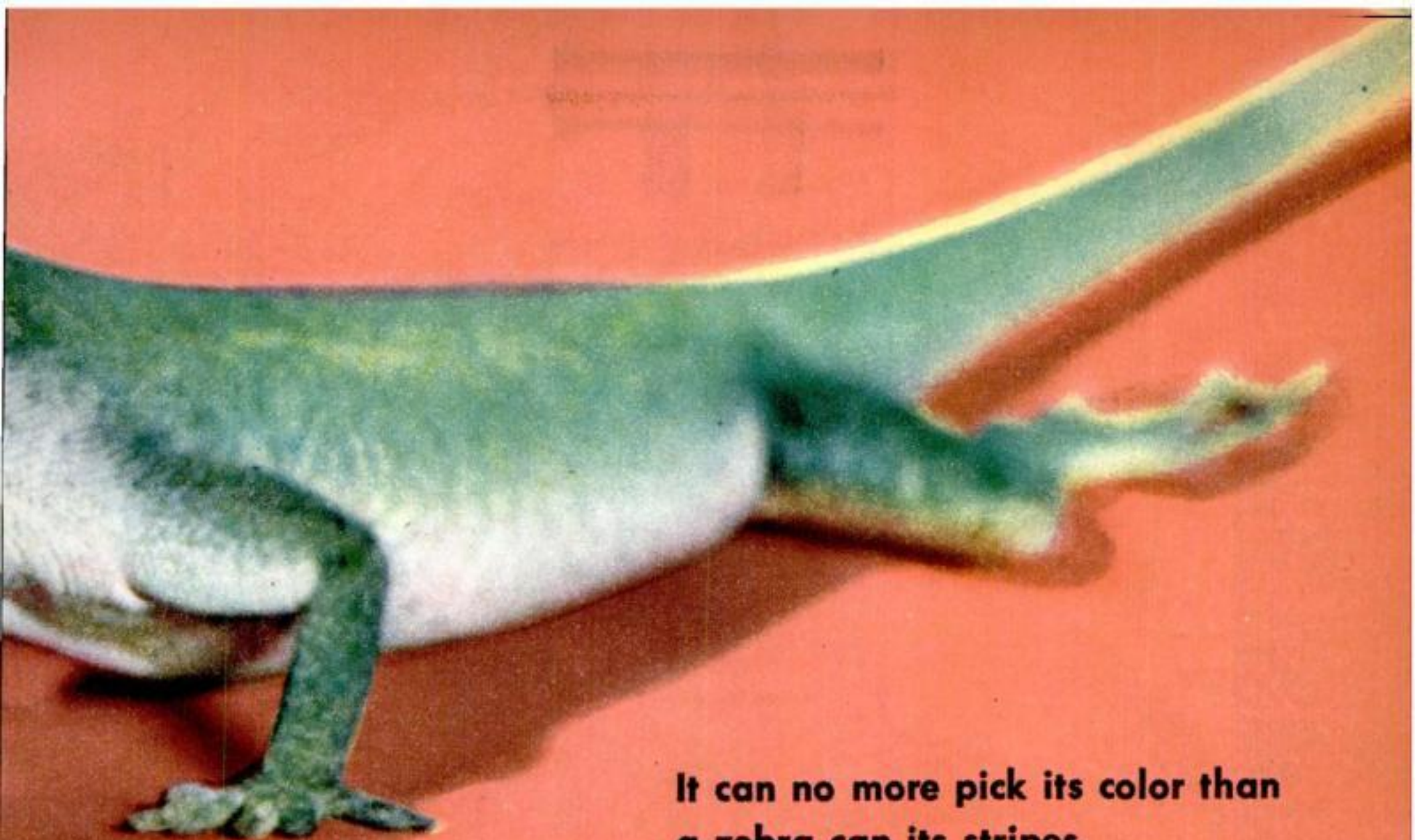
PSM photos by W. W. MORRIS

EXPOSING the Chameleon



Probably the story of the chameleon that went crazy trying to match a Scottish plaid has contributed to the unfounded belief that a chameleon can conform to the coloring of its surroundings. When the picture above was taken, the reptile showed no mental instability over its failure to do something about the plaid on which it crouched. Zoologists agree that the sub-lizard assumes a green phase when it is excited, frightened, angered, asleep or dead—and for no other condition.

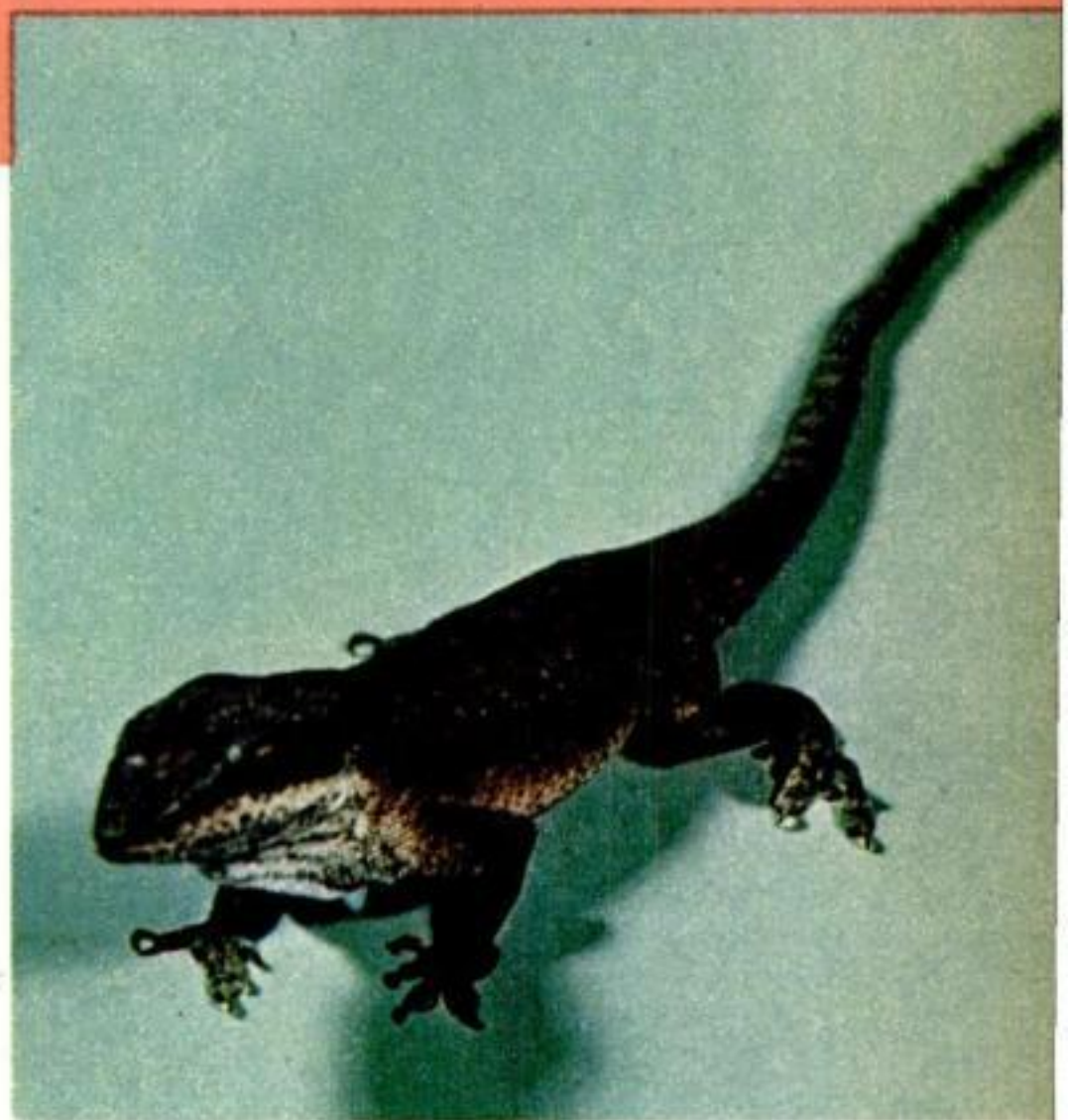
The color of the plaid on which the chameleon rests in this photo remains the same. Outward conditions have changed, however, and the chameleon has been forced to abandon its green hue for brown. The reptiles take on a brown discoloration in response to low temperatures, hunger or strong sunlight. In this test the creature still displays no signs of losing its senses over its futile struggle with the plaid. It takes about three minutes for a chameleon to change completely from one color to another.



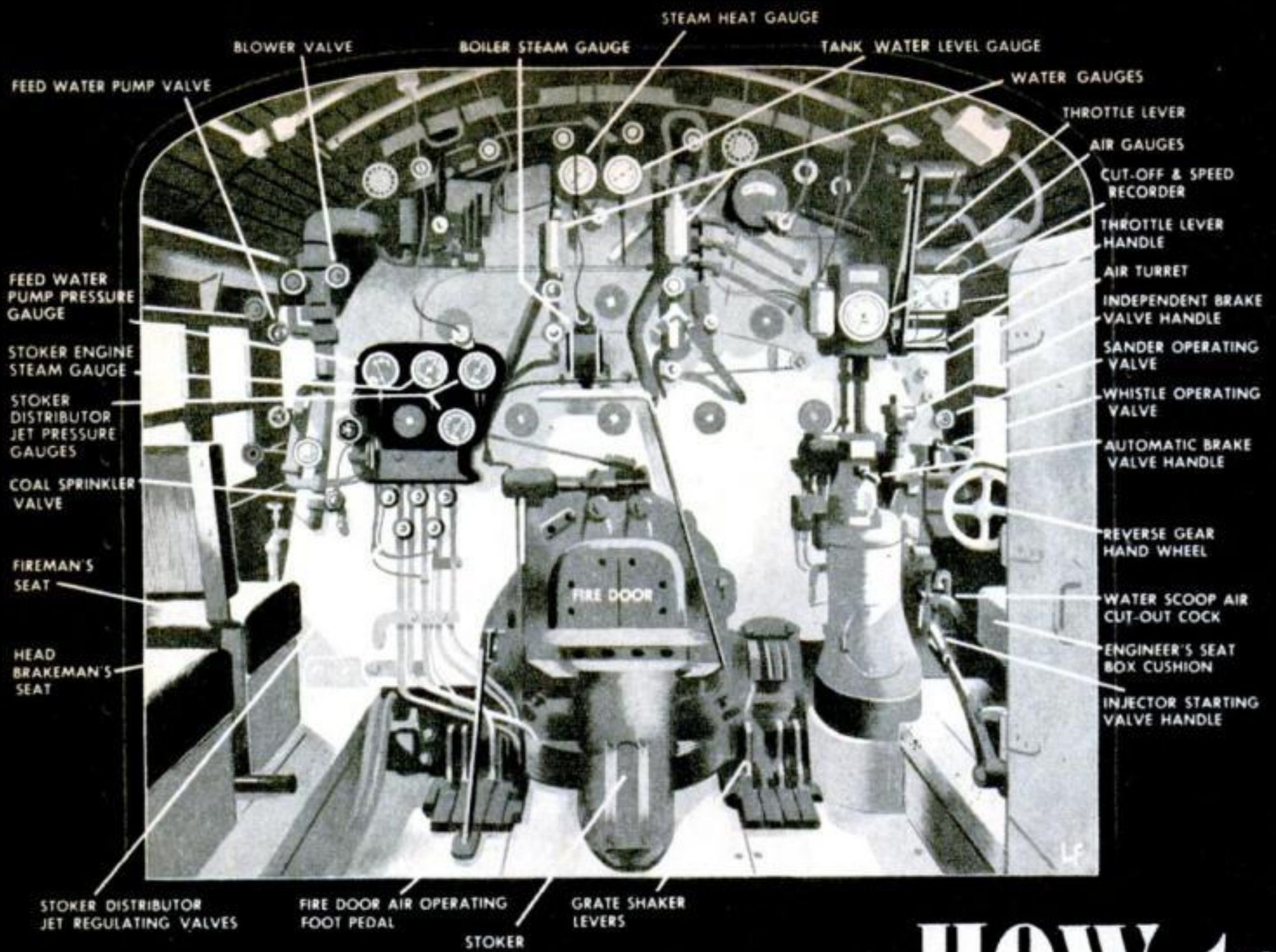
It can no more pick its color than a zebra can its stripes.



The chameleon in this picture remains brown against a background of yellow. The New York Zoological Society, where these tests were staged, explains that the sub-lizard has three types of color changes: (1) uniform brown above and flecked with brown below; (2) pure, pale green above and white below; (3) mottled brown above and flecked with brown below. Sometimes the color is bright green or intermediate shades of light brown, yellow, yellow green or emerald green. American chameleons are found in Southern states.



Blasting forever its reputation for free-wheeling color changes, the chameleon in this final photo remains brown against a green background. In the picture at the top of these pages the reptile showed that it had the ability to turn green, yet here with all the encouragement of its surroundings it retains its brown color. Brayton Eddy, acting curator of reptiles for the New York Zoological Society, points out that male chameleons in courtship or combat sometimes display a brilliant red dewlap, or throat fan.



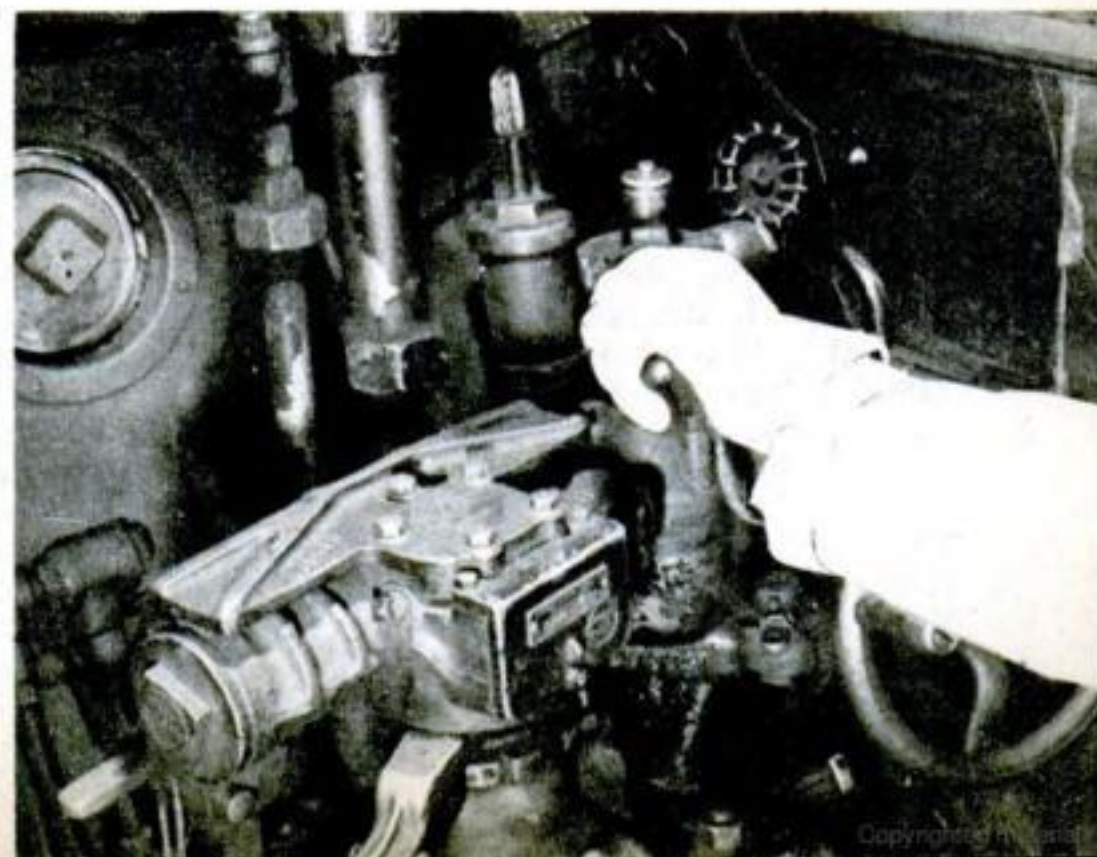
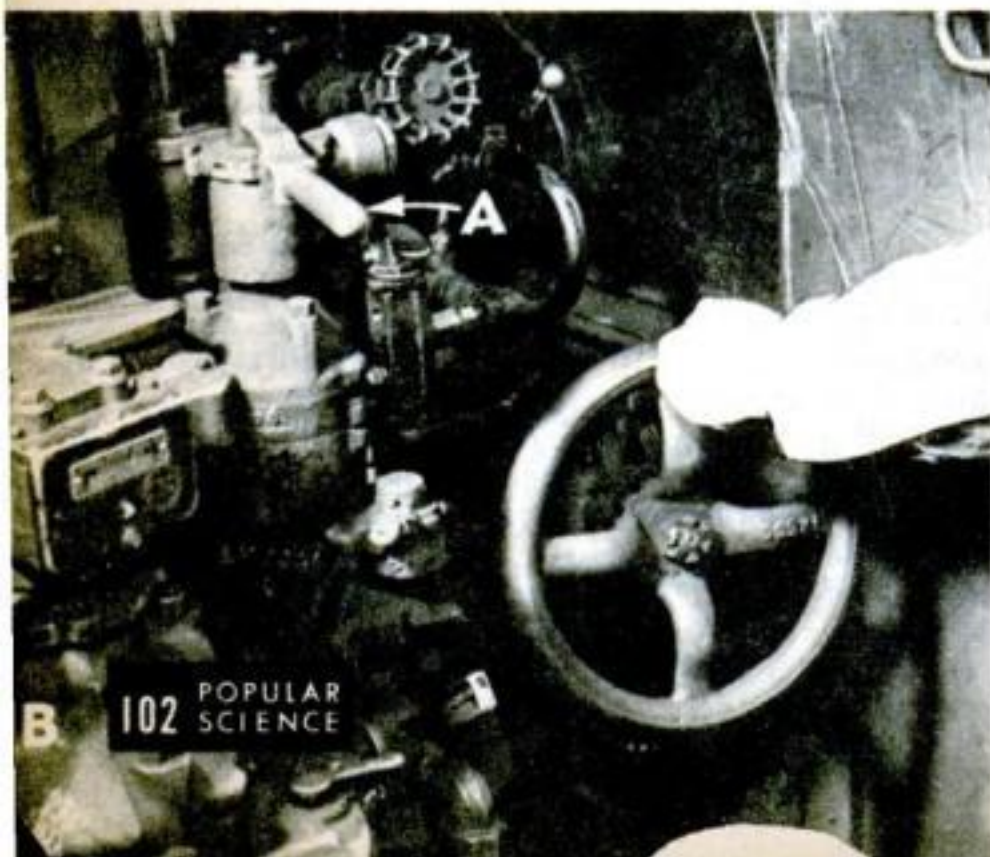
HOW to

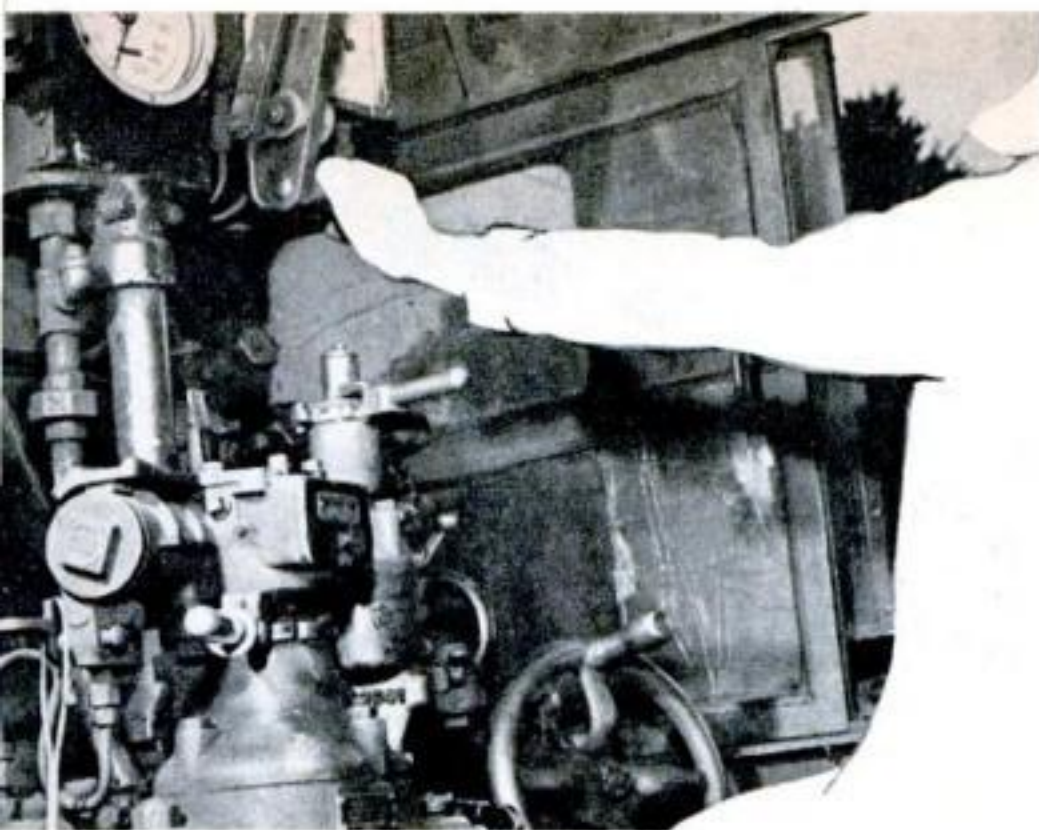
Driving a locomotive is essentially simple, but the finer points of an engineman's work make it one of transportation's most demanding jobs. The pictures on these pages show the principal parts of the job and give some idea of the myriad details that make

it hard. Above is a simplified drawing of the cab of a New York Central Niagara-type locomotive. With tender two-thirds loaded, the engine weighs 808,400 pounds; it is 115½ feet long. Your seat for the demonstration is on the right of the cab.

1. With brakes, water level, steam pressure and dozens of other items checked, your engine is coupled to a 17-car passenger train. You turn the reversing screw full right for maximum piston stroke. Note that independent engine brake (A) is in "on" position. It had to be set while pictures were taken on a siding. Train brake (B) is in "off" position.

2. You release the independent brake, used to hold train in station, before opening throttle. As train gains momentum, the reversing screw is gradually turned left, toward the neutral position, to shorten piston stroke and increase speed. The screw's function is somewhat similar to that of the spark on an automobile engine.





3. Open the throttle gradually, depressing the latch to disengage teeth from ratchet that sets the throttle for a given speed. The locomotive's eight drivers carry 275,000 pounds of its weight, giving sufficient friction to start the train. The \$300,000 engine is so powerful that it isn't necessary to "take the slack"—bunch the cars to lighten initial load—before starting.

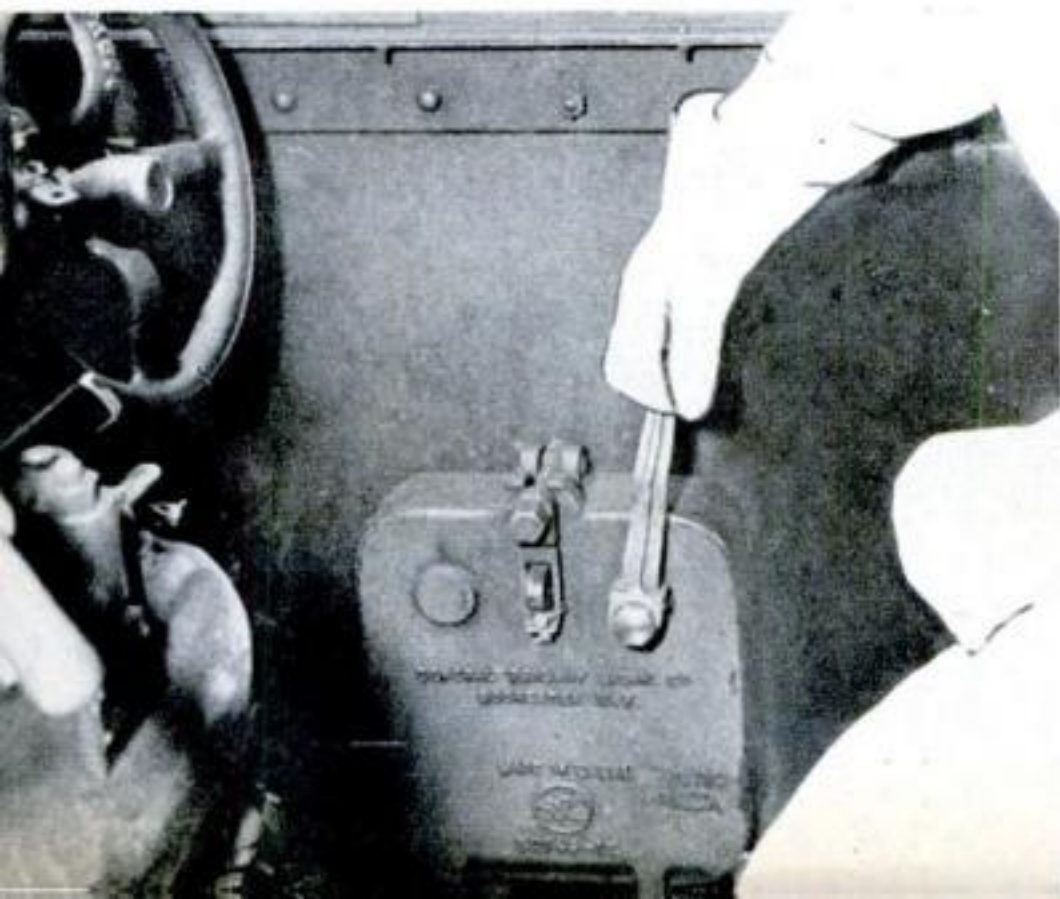


4. To keep from "losing the rail," or slipping, you put some sand on the track—but it isn't as easy as it sounds. The throttle has to be closed to let the engine "drift" during sanding, or the sudden jolt as wheels catch might break pins on drive wheels or loosen their tires. A whistle in the cab blows while the sander is in operation so that engineman won't forget to shut it off.

DRIVE a LOCOMOTIVE

5. Well on the way, you encounter the first yellow caution signal and slow down so that you can stop within the range of your vision, as the next signal block may order you to do. To pass a caution signal, the forestalling lever is pulled back. If lever is not pulled, brakes will be set automatically by the block signal system's safety devices. If the forestalling lever is held back for more than 15 seconds, the brakes set anyway.

6. A clear track ahead. Occasionally, you glance at boiler water level, steam gauge and other dials. If the water level is too high, water may seep into the cylinders, sacrificing power; too low a water level invites damage to crown sheet and a possible explosion. All the way, you keep your eyes open for signals. In engineman's parlance, the track on this side of a signal is yours, that beyond the signal belongs to the railroad company.



The 19-inch station wagon at right has a hardwood body like an original. The doors open and close and there are enough seats for a whole doll family. Made by Buddy "L" Toys, of Glens Falls, N. Y. About \$6.



At left: A calliope for the nursery circus makes music electronically with regular radio tubes. Produced by Tee Gee Metal Industries, of Brooklyn, N. Y., it has sharps and flats to familiarize a child with the piano keyboard. About \$20.

The Return

This year's mechanical marvels are sturdier, more realistic—and more expensive.



At left: This 8½-lb. racing car is driven at speeds of 75 to 90 m.p.h. by its two-cycle gasoline motor. The cast parts are magnesium; the tires semi-pneumatic. It is manufactured by Dooling Bros., of Los Angeles, Calif. Body, \$45; engine from \$22 to \$35 more, depending on type.

At right: When Junior pulls the string, Flippo will flounder along on his flippers across the floor, spinning a block on his nose. Flippo, who has no springs or wheels, is manufactured by the Noma Electric Corp., of New York. About \$2.

At right: This streamlined ship, unlike many models, is a liner of the future, not the past. The two-foot E-Z Craft Model comes as a kit of prefabricated parts to be assembled and painted. About \$3.

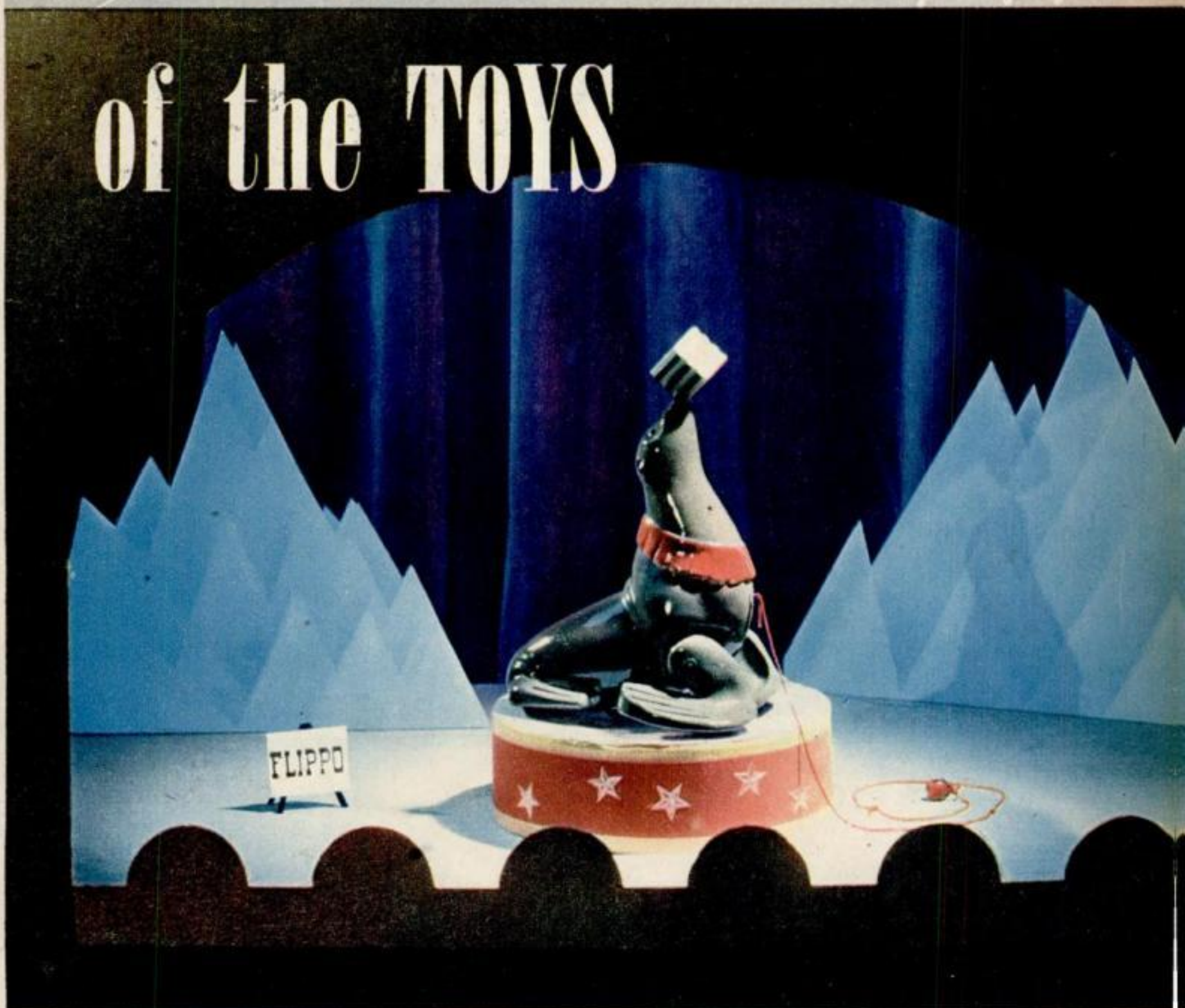




The sturdy little "Buzza" choo-choo, above, goes 'round and 'round and 'round on a self-contained flashlight battery. The current vibrates a spring shoe in the engine that pushes against the notched track. No wires or winding. About \$5.

A child will find himself making invisible ink before he can say "potassium thiocyanate" with Lionel's new Chem-Lab, above. A comic book, each page explaining a chemical experiment, carries him along to the story's conclusion. About \$8.

of the TOYS





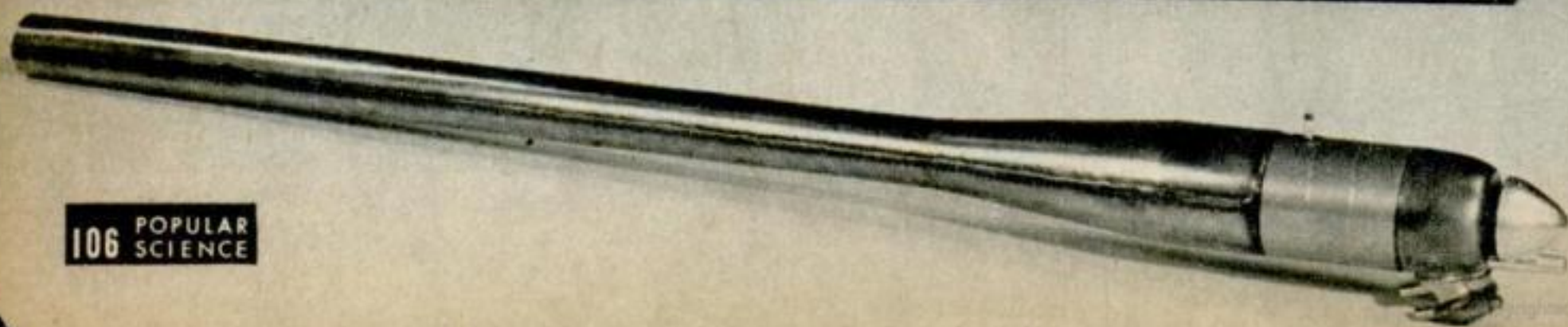
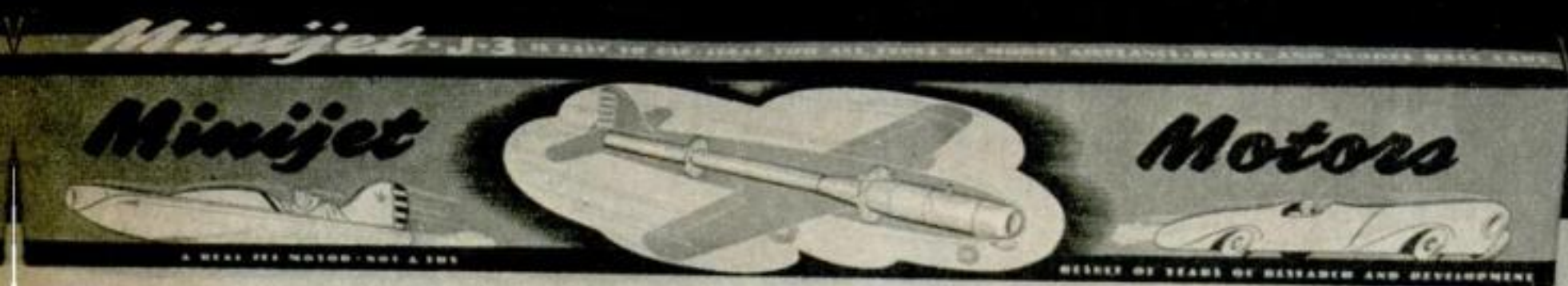
New scooters. At left: A three-wheel model made by the Tennessee Aircraft Corp. About \$15. Above: A ratchet-drive model made by Coaster Craft Scooter. About \$15.

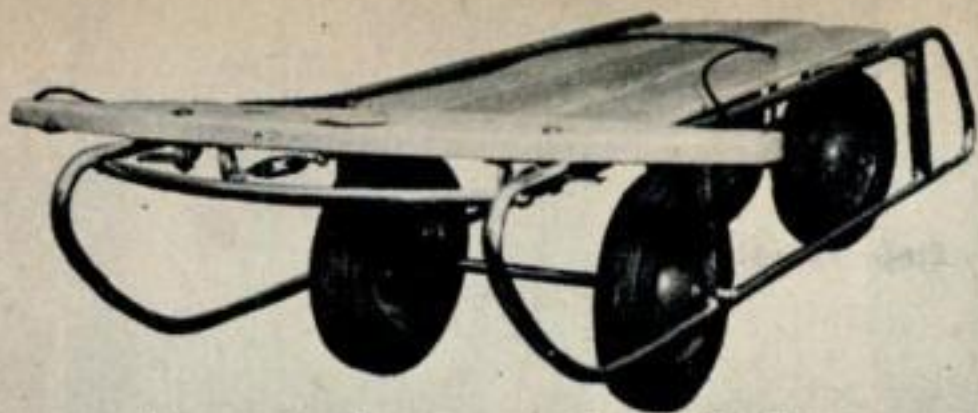
Below: This 26-pound, 40-inch-long "handcar" operates like the real thing—by moving its hand levers forward and backward. It is made by the Kalamazoo Mfg. Co. About \$18.



Below: This miniature reaction engine is made by Minijet Motors for model planes, racing cars and speedboats. It uses regular gasoline, has a three-pound thrust, weighs 16 ounces. About \$35.

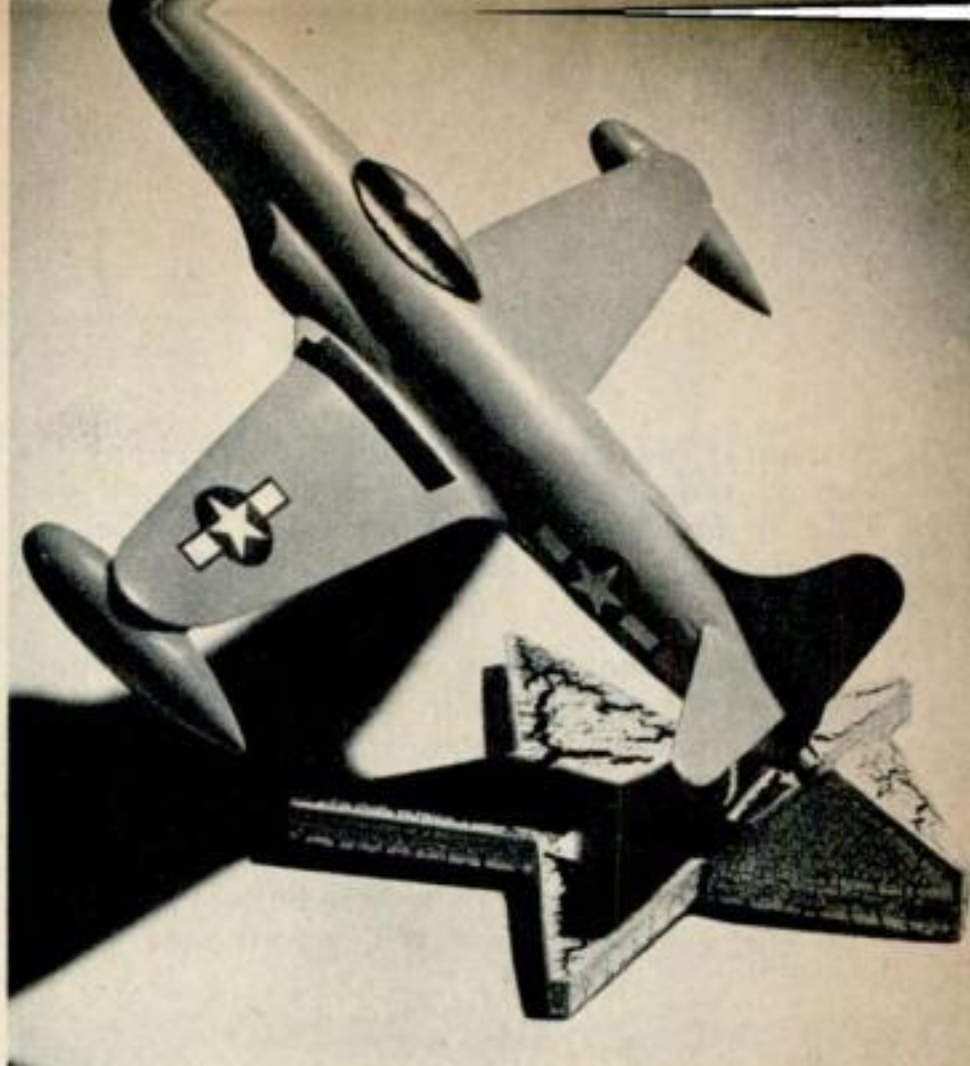
Above: Bridges, skyscrapers and a variety of other structures can be built with this aluminum construction set. It includes a riveting tool and blueprints. It is a Fox Toy Co. product. About \$3.





Above: In the summer the Sledmobile can be used as a wagon and in the winter, with its cotter-pinned wheels removed, as a sled. It's a space saver—and handy. About \$30.

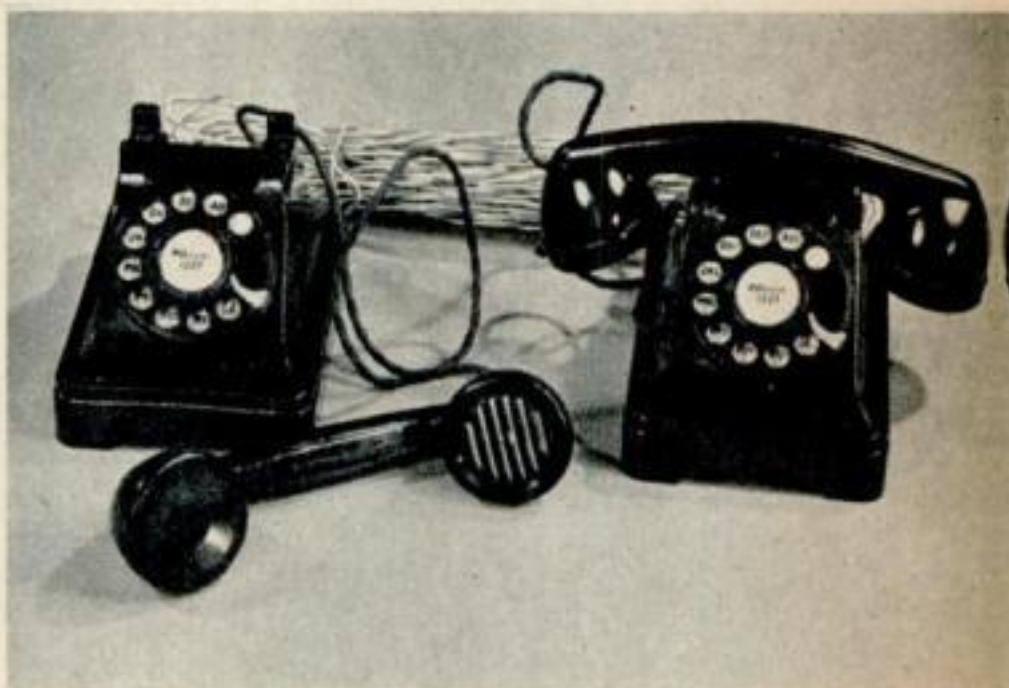
At right: Keeping up with the times, model-airplane builders now stress jet planes. Mel Farrell's Shooting Star kit is made to scale. About 75 cents.



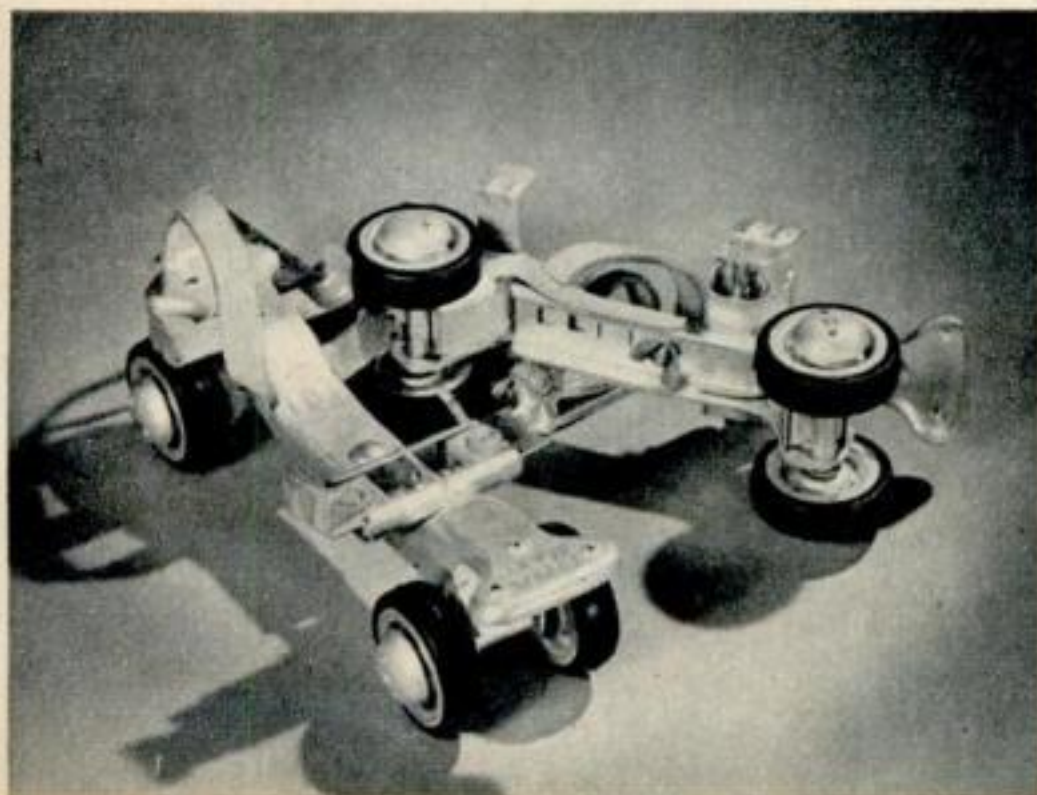
Below: Precision-molded for balance, with a smooth surface that reduces air and point-of-contact friction, the plastic top is a marathon spinner. Made by Plastic Molded Products, Inc. About 50 cents.



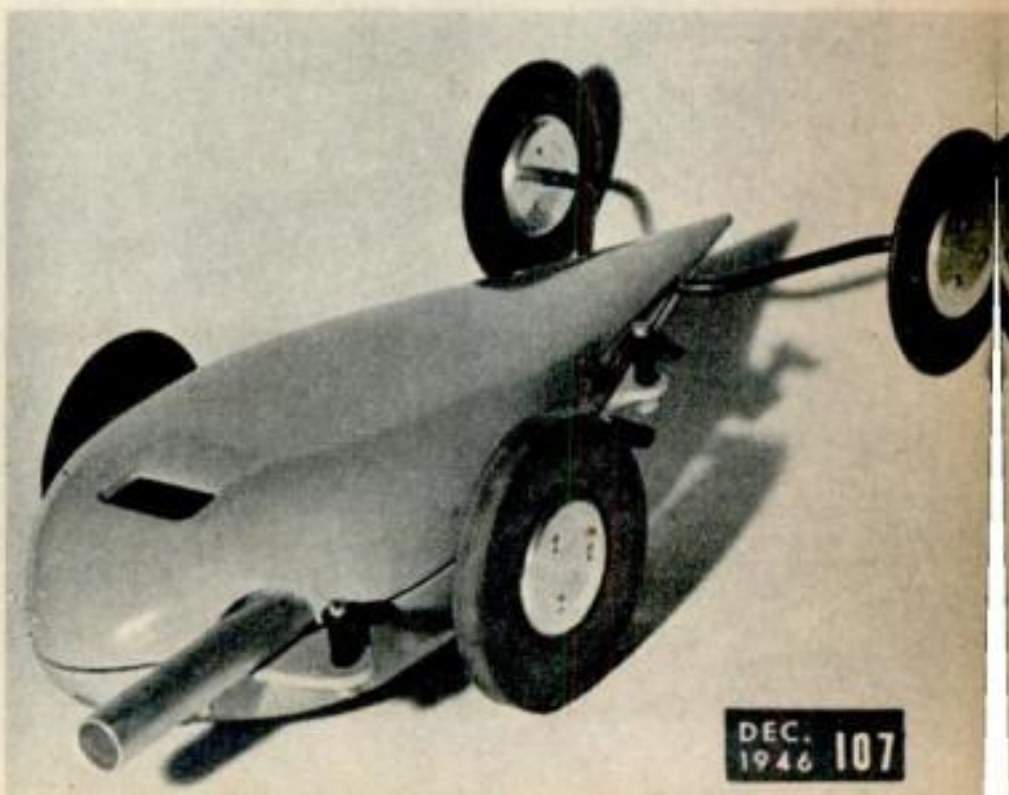
Below: This three-quarter-size telephone set can be used for room-to-room calls. Flashlight batteries supply its current. Pengo, Inc., makes the set, which includes 50 feet of wire. About \$12.



Below: Knee-action wheels are featured in the Keeco Flyer aluminum roller skates. A pair of the skates weighs a pound, needs no oil. About \$7.50.



Below: The 8½-pound McCoy car has gone 116.4 m.p.h. A ram-air-intake gas engine costs from \$22 to \$35; the car, without engine, about \$42.50.

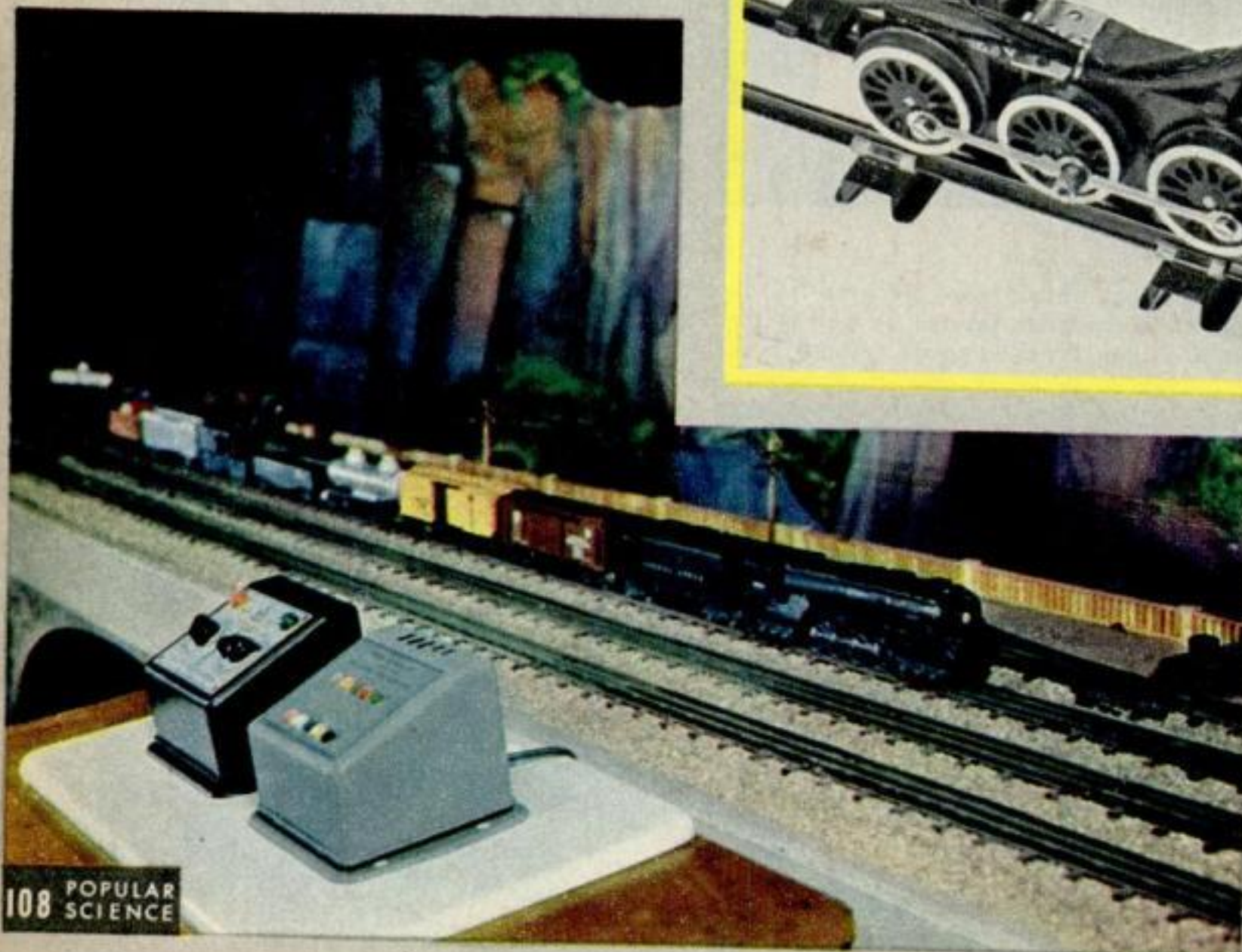
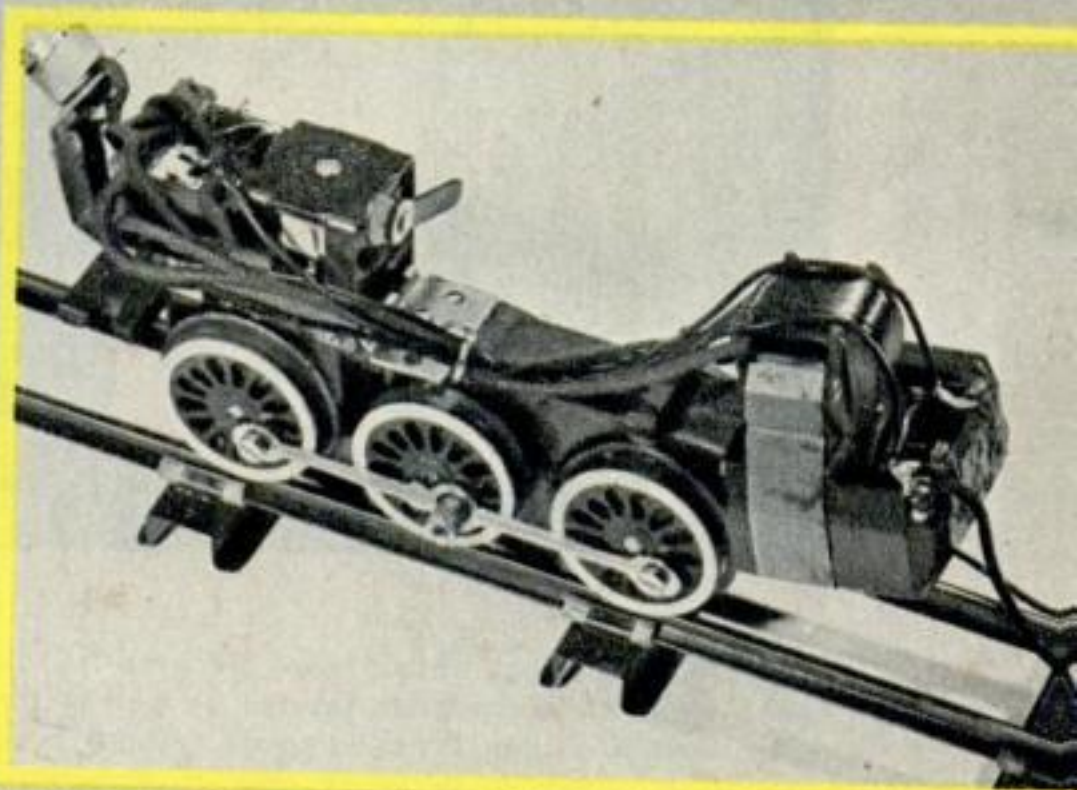


A magnet hidden in his mouth enables Nippy the Pup to snap at a metal-cored plastic bone and hold it fast. Made by Winchester Toy Co., of Philadelphia. About \$6.

Lionel trains have gone electronic. Ten different medium-frequency waves, controlled by buttons on the transformer below, stop and start trains, couple and uncouple cars, sound the whistle, and activate unloading devices—all anywhere along the line. The tiny receivers are no bigger than a watch. The smoke-puffing train in bottom photo sells for \$75. Service stations will convert older types.

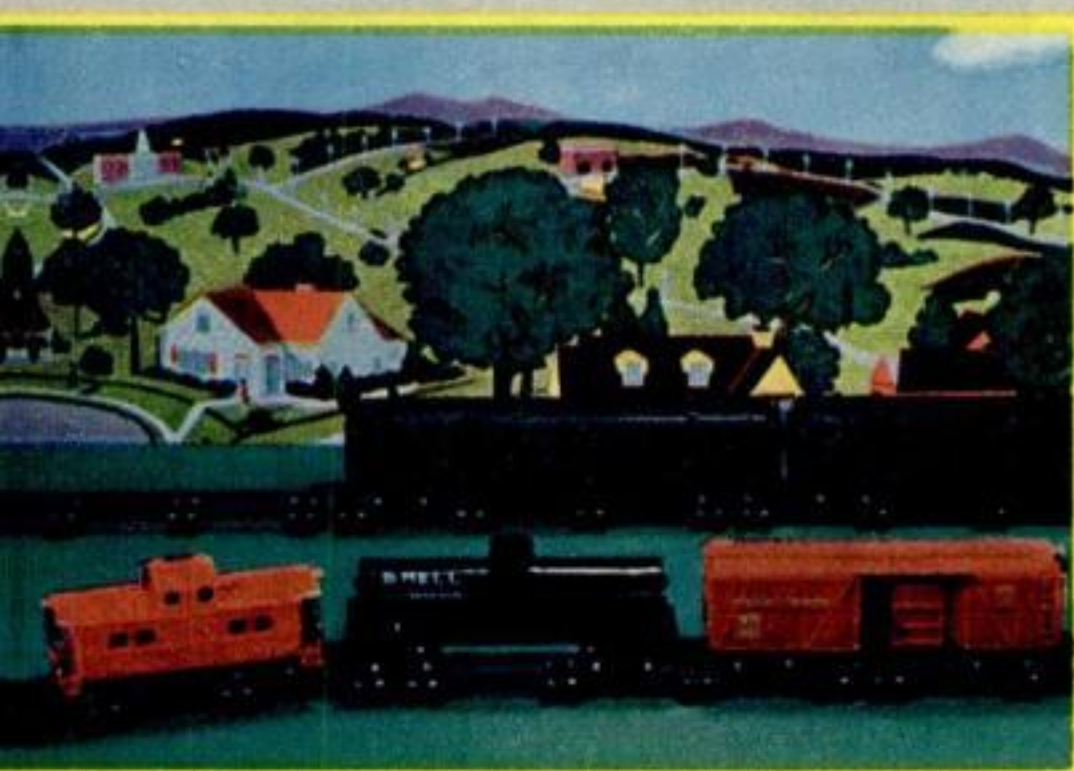


Below: Gilbert's American Flyer trains are now powered by motors developed to operate Grumman Hellcat wing flaps. The locomotives smoke, too.





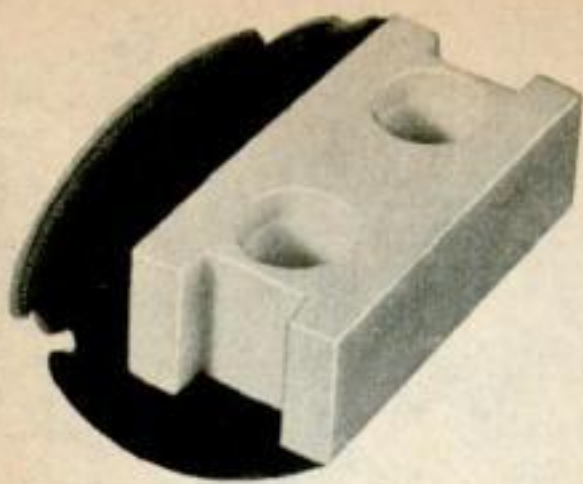
Below: The scale-model American Flyer cars are plastic and weigh only one-third as much as metal cars, permitting longer, more realistic trains.



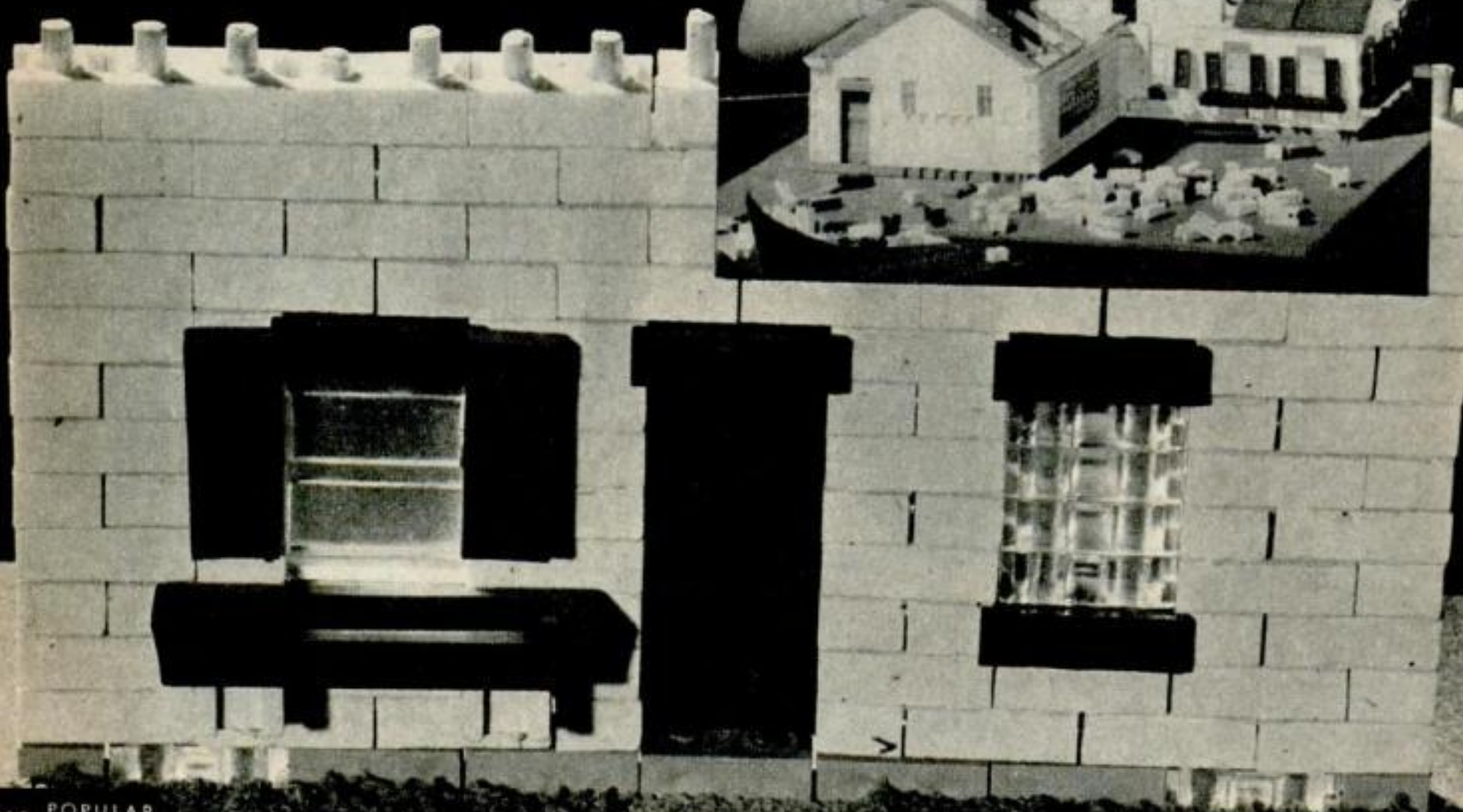
Above: From England come these miniatures of standard English automobiles, powered by spring motors. They are made by Tri-Ang Minic Lines Bros., Ltd., of London. The larger types, \$2; the smaller, \$1.25.

This scale-model bucket loader works just like an original. The model earth hauler dumps its load when a lever is pressed. The Charles W. Doepke Mfg. Co., of Cincinnati is not yet in full production. Bucket loader, about \$14; earth hauler, \$12.75.





Latent construction talents of the playroom set can be developed—if father doesn't steal the act—with the Vinylite plastic building sets produced by the Du Page Plastics Co. A complete village (upper right) of 30 buildings can be built with plastic bricks (above), scaled $\frac{1}{4}$ inch to one foot. In building, dowels are inserted in a perforated baseboard and the blocks are slipped on the dowels. The village comes with homes, stores, factory, public buildings, gas station, theater, hamburger stand, airport building and a real electric-light plant. Then there are windows, doors, shutters, flower boxes, imitation glass bricks, sandpaper strips for streets, and toweling to represent grass and shrubbery. The boy at right is building a typical home. Below is a wall showing the supporting dowels. The sets come in 10 sizes, the smallest with 400 pieces for \$4, the largest with 3,500 pieces for \$27.50.



I'd like

Cartoons by
SYD LANDI

Everybody has his own pet idea of some gadget he would like to see in general use. What is YOURS? *Popular Science Monthly* will pay five dollars for every such suggestion that its editors decide to publish.



Ball-Repelling Panes. Windowpanes of a plastic able to shrug off a wild baseball without damage would be reassuring to Frank Raimo, Jersey City.



Sneeze Trap. Coughers or sneezers who attend shows and concerts should carry small, soundproof boxes to catch their noises, thinks Hildagarde Herzinger, Chicago.



Bandit Catcher. To disarm bandits, James Ledbetter, Atlanta, Ga., would equip stores with loudspeakers that, when set off by a clerk's foot, bark "Drop that gun!"



Electric Fishhook. To stun hooked fish and make certain the big ones are landed, Paul G. Cluver, Watseka, Ill., suggests a fishhook charged with electricity.



Eraser Key. An extra typewriter key that would merely have to be pressed to erase mistakes would be a boon, according to John Dosland, Moorhead, Minn.



End Handles on Luggage. Aboard crowded trains, end handles would let bags be carried the long way and thus save space, says Mrs. Robert Graham, Cameron, Ill.



Plastic Bearings Tell All

NEW transparent plastic replicas of bearings are helping Westinghouse engineers design smaller motors with more power. They can look right into the bearing while the machine is running and watch the oil, dyed red, flow into the various parts of the bearing. Thus a check can be made on whether the seals are working properly, oil passages are allowing the correct flow of lubricant, and relief points are properly located. Bad design starves some areas of oil and the bearing cannot carry a full load. Previously, designs were determined largely by trial and error. The bearing models are machined out of Lucite with the same close tolerances as the metal originals.

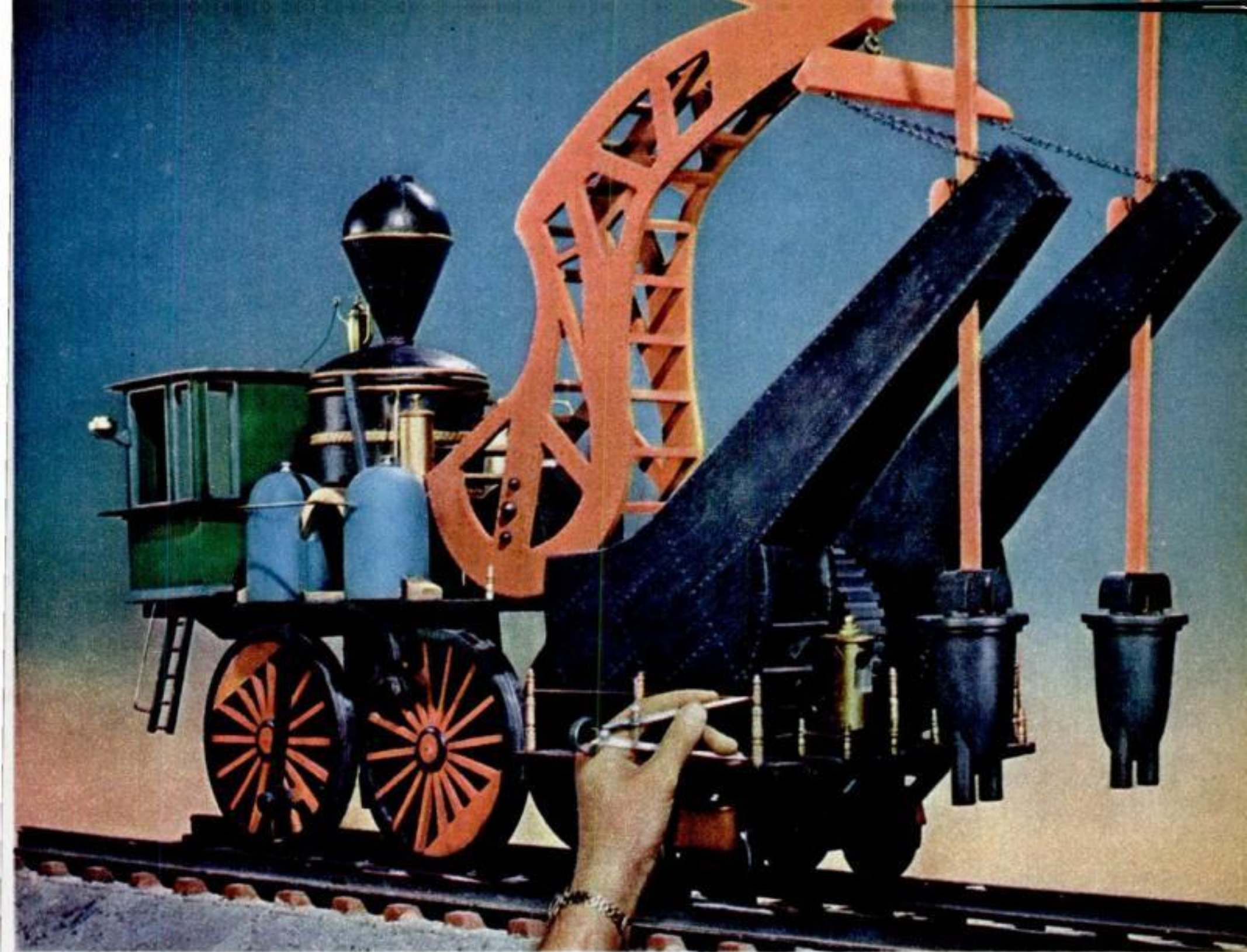
Camera Theodolite Tracks "Old Needlenose"

FOLLOWING the flight of pilotless aircraft that travel at supersonic speeds requires special instruments. The tracking theodolite, below, is equipped with recording apparatus and geared to an automatic motion-picture camera. By using this device in combination with radar, a missile can be followed from the moment of launching until it comes to earth again. The theodolite, being examined by engineers S. L. Lewis and Waine Archer, permits a permanent record to be made for later study.

Boeing photos by Verné Manton.



The camera theodolite was developed for use with Boeing's "Gapa" rocket, here shown soaring aloft. Theodolite and radar stations, one to six miles from the launching tower, will record flight of the missile, nicknamed "Old Needlenose."



Inky Poo, the machine that drives spikes by the pair, is John Henry's opponent. It is an imaginative creation of plastic, metal and rubber to delight any model maker. Hand indicates the scale.

Ingenious Models Bring John Henry Folk Saga to Movie Life

JOHN HENRY was the fabulous super-strong man of the workers who built the railroads, just as Paul Bunyan was of the lumbermen. John Henry's great contest against the machine is an epic of American folklore. Now George Pal, cartoon-movie maker, has brought the story to the screen,

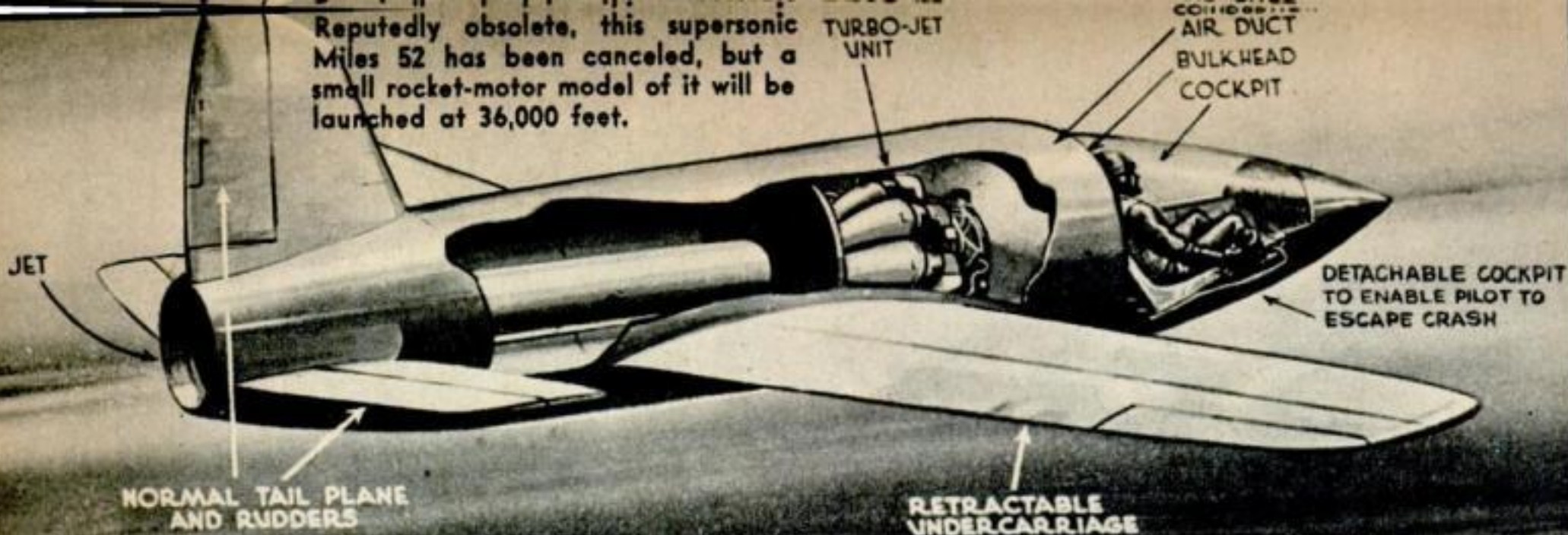
matching John Henry against a fantastic steam track-laying and spike-driving machine named "Inky Poo." Seven plastic torsos, 73 pairs of wooden legs and 42 rubber heads make John Henry "move," and Inky Poo, of course, is also shifted into a new position between each frame.

Inky Poo and John Henry start at the mouth of a tunnel to see who can first lay track to the finish.

True to legend, John Henry wins the race with his mighty hammers flying but kills himself to do it.



Reputedly obsolete, this supersonic Miles 52 has been canceled, but a small rocket-motor model of it will be launched at 36,000 feet.



Britain Goes Supersonic

Engineers race to design first plane to fly faster than sound.

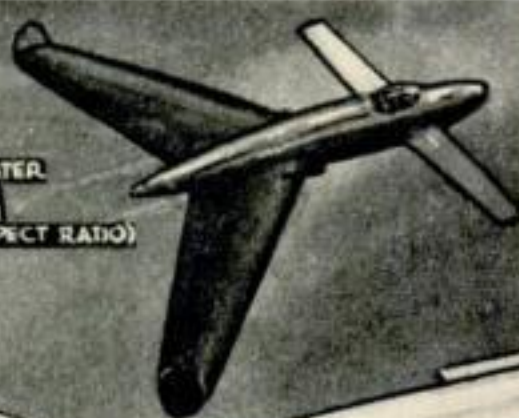
BRITISH engineers are making an all-out attempt to build aircraft that fly faster than the speed of sound. To do it they are concentrating on developing gas turbines, jet propulsion and rocket engines.

British airplanes have broken existing world speed records in recent months. Now British experts are developing engines and planes to set fresh marks. Hint of what they are like is given by the canceled Miles 52, apparently obsolete even before completion. The M-52's 17,000-hp. three-stage power plant almost filled the fuselage. Ex-

haust from a jet engine with centrifugal blower ran a gas turbine. This brought more air into the stream and pushed it into a duct. Here more fuel was burned to give an extra push. The plane was expected to hit 1,000 m.p.h., 250 m.p.h. faster than sound. The ones under wraps presumably are planned to do even better.

The solution of supersonic difficulties is complicated by the fact that ordinary wind tunnels cannot be used for testing. Air bounding off the sides sets up disrupting currents, and a shock wave "chokes" the tunnel. For this reason British engineers are using various types of pilotless models, some dropped from high altitudes, some depending on rockets.

THE "FLYING DUCK" TYPE.
AN AIRCRAFT DESIGNED TO FLY FASTER THAN THE SPEED OF SOUND, HAVING REAR WINGS WITH LARGER SPAN THAN CHORD (I. E. HAVING LARGE ASPECT RATIO)



Various designs proposed for supersonic aircraft. The swept-back wings and delta designs are intended to cut drag but offer control difficulties if used at low speeds.

SHARP-POINTED FUSELAGE.

FRONT WINGS WITH ONLY SHORT SPAN AND LARGE CHORD (LOW ASPECT RATIO).

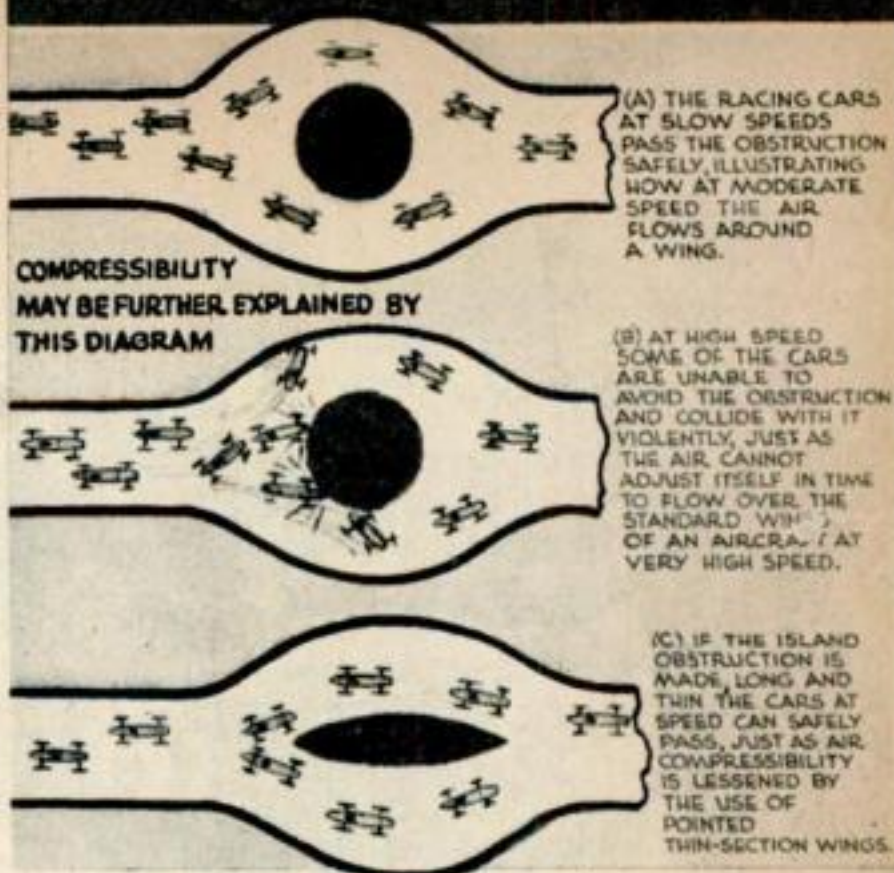
POSSIBLY THE TWO WINGS MAY BE CONVENIENTLY COMBINED INTO THIS TRIANGULAR "DELTA" DESIGN.

A GERMAN "DELTA" PROJECT BY DR. LIPPICH.

TO AVOID COMPRESSIBILITY AND REDUCE "WAVE DRAG" THE WINGS OF SUPER-SONIC AIRCRAFT MUST BE THIN, BI-CONVEX AND SWEEPED BACK.



COMPRESSIBILITY MAY BE FURTHER EXPLAINED BY THIS DIAGRAM

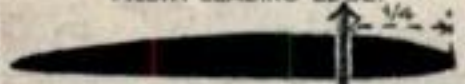


SUPER-SONIC

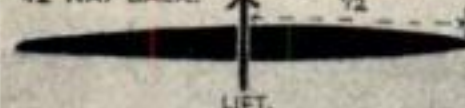
SUB-SONIC

The subsonic wing, at left below, piles up compressed air ahead of it at speeds approaching that of sound. The supersonic wing, at left above, is "biconvex,"—thinner and more pointed to cut through the air.

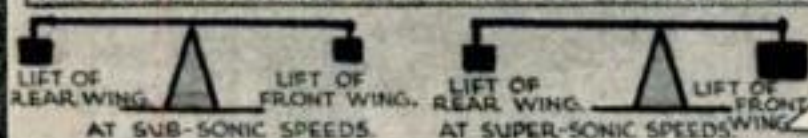
AT SUB-SONIC SPEEDS THE LIFT OF A WING IS AT A POINT 1/4 BACK FROM LEADING EDGE.



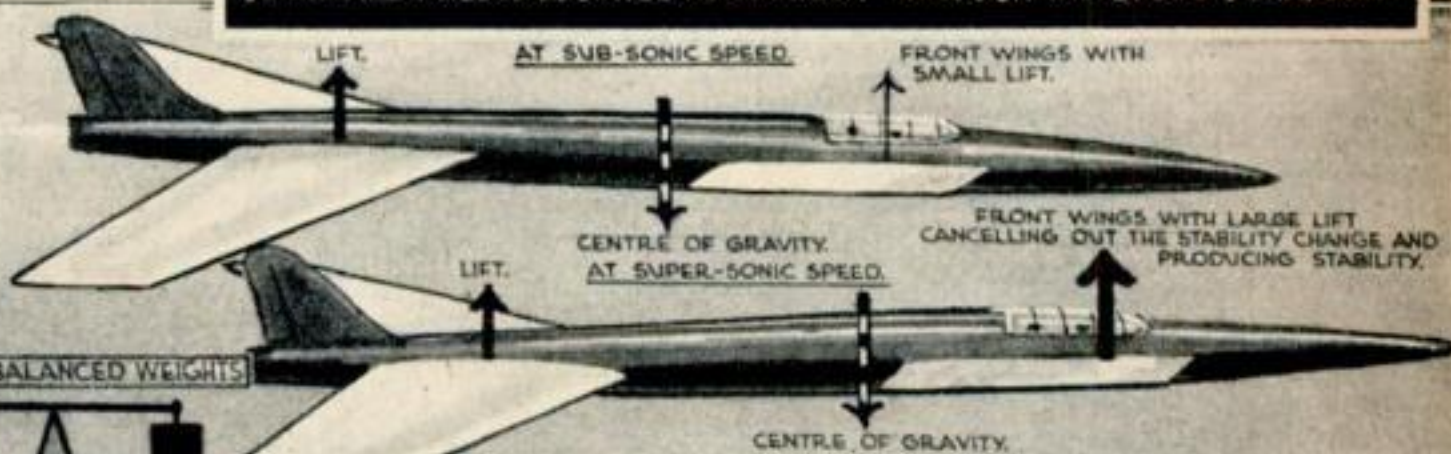
AT SUPER-SONIC SPEED THE STABILITY CHANGE OCCURS AND THE LIFT MOVES REARWARD TO 1/2 WAY BACK.



THE STABILITY CHANGE ILLUSTRATED BY BALANCED WEIGHTS



"STABILITY CHANGE" ASSOCIATED WITH FLIGHT THROUGH THE SPEED OF SOUND



IF AN AIRCRAFT IS TO BE STABLE (I.E. FLY STEADILY AND CONTROL EASILY) THE FORCES FROM THE TWO WINGS MUST BE BALANCED ABOUT THE CENTRE OF GRAVITY OF THE AEROPLANE.

Above: Rearward shift of the center of lift at supersonic speeds must be balanced by front wings whose lifting power increases. Below: These aircraft, British, American and German, have special shapes to delay compressibility troubles.



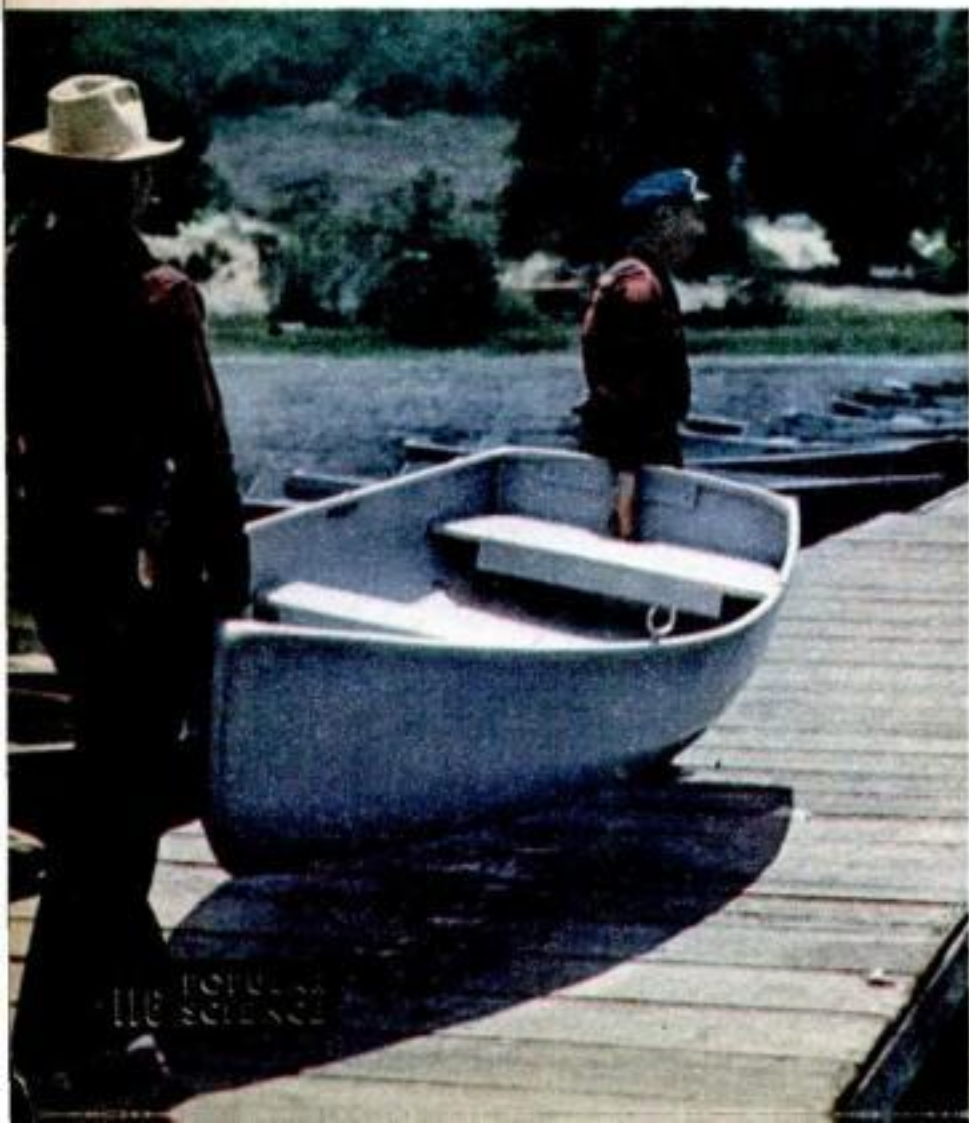


Conveyor-Belt Harvesting. Lettuce and other crops on big western ranches are being gathered more quickly with the help of conveyor belts like the one shown above in an Arizona lettuce field. Fifteen men feed each of the belts, which move through the huge fields at two miles an hour.

The belts, rumbling along on gas-pipe rollers, are 30 inches wide and 135 feet long, and each is powered by two 85-hp. Ford engines. They carry the produce up above tractor-drawn trailers and drop it into steel baskets. The machines are made by the Gaudin Motor Co., of Salinas, Calif.

Aluminum Rowboat. Douglas Aircraft makes this rowboat of airplane-type .040-gauge dural. The surface is anodized to make it corrosion-proof, seams are riveted and spot welded, and air tanks maintain buoyancy even if craft fills with water.

Durable Orchid. Made of Lumarith plastic, the once-fragile orchid becomes washable and long-wearing. William Farris, of Alhambra, Calif., began making the flowers in a navy hospital; now 10 disabled veterans turn them out in his home factory.



CRAFTWORK

PROJECTS OF THE MONTH

SHOPPING days before Christmas don't count when the presents are turned out in your own home workshop. Despite appearances, the three projects here can be built in short order, and with little cost for the materials used.



TIN-CAN STOCK IN THE LAMP shown at top is good material for decorating with paint and decals and may be cut from a 2- or 5-gal. can. The project is described on page 162.

A GAME OF SHOOTING DISKS, in the photo at center, calls for just enough skill to give all members of the family a thrill. How it is built and played is told on page 151.

DIMPLES IN COLOR make the little basket of clear plastic just at left something different. Construction steps are also on page 151.



NEW IDEAS from the INVENTORS

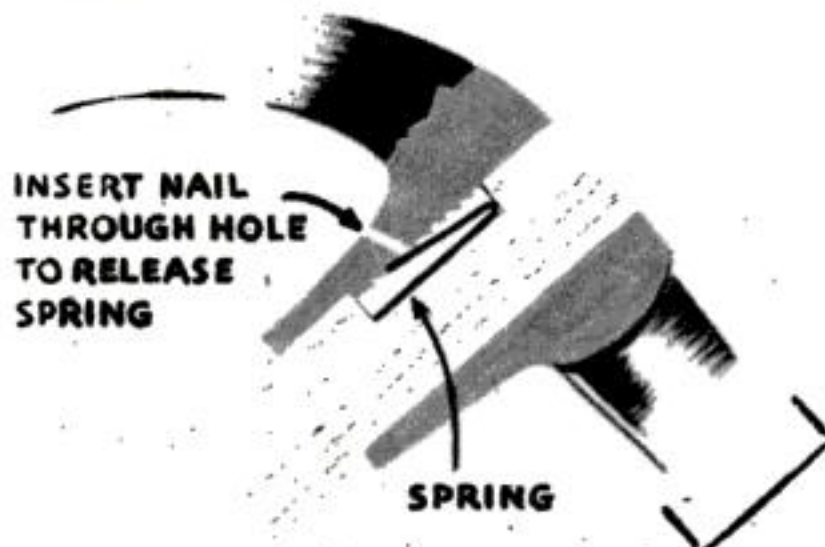
Combination Spoon and Fork.

This ingenious instrument, designed by Samuel Lapin, of New York City, works both ends with one handle. One end is a conventional spoon; the other, a two-pronged fork. It spoons or spears fruit from a jar, or from a drink that it also stirs. The fork is suitable for sea food.

Hammer-Head Lock. The menace of hammer heads that fly off the handle is met by a device developed by Vincent Iavarone, of New York City. The inner face of the hole in the head is notched and the handle recessed to hold a hairpin-shaped spring. The two ends of this spring, pushed together when the handle is forced into the hole, spring apart once it is in position, catching one end in the notches and locking on the head.

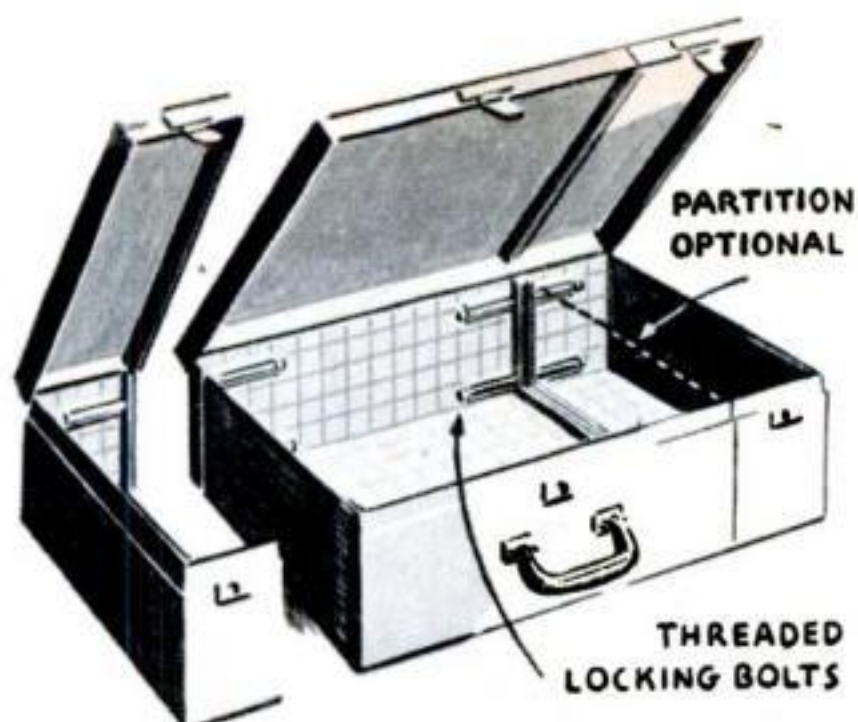
INSERT NAIL
THROUGH HOLE
TO RELEASE
SPRING

SPRING

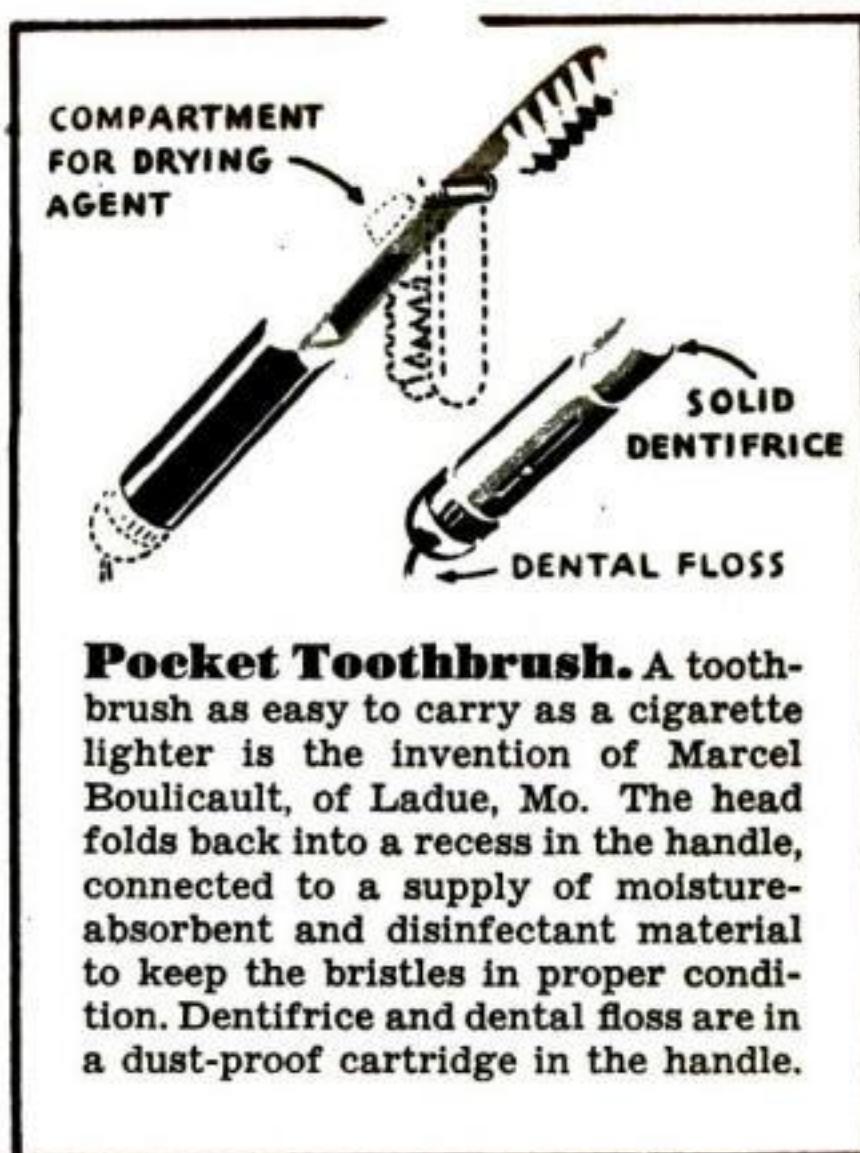


Leaky-Tire Alarm. A clapper warns you of improper tire inflation in a device invented by Arthur M. Heath, of Houston, Tex. A double-action valve, set inside the hub cap and connected with the inner tube, remains closed only when the pressure is just right. Low pressure or over-inflation opens the valve, allowing air to operate a tiny motor that bangs the clapper against the inside of the hub cap.



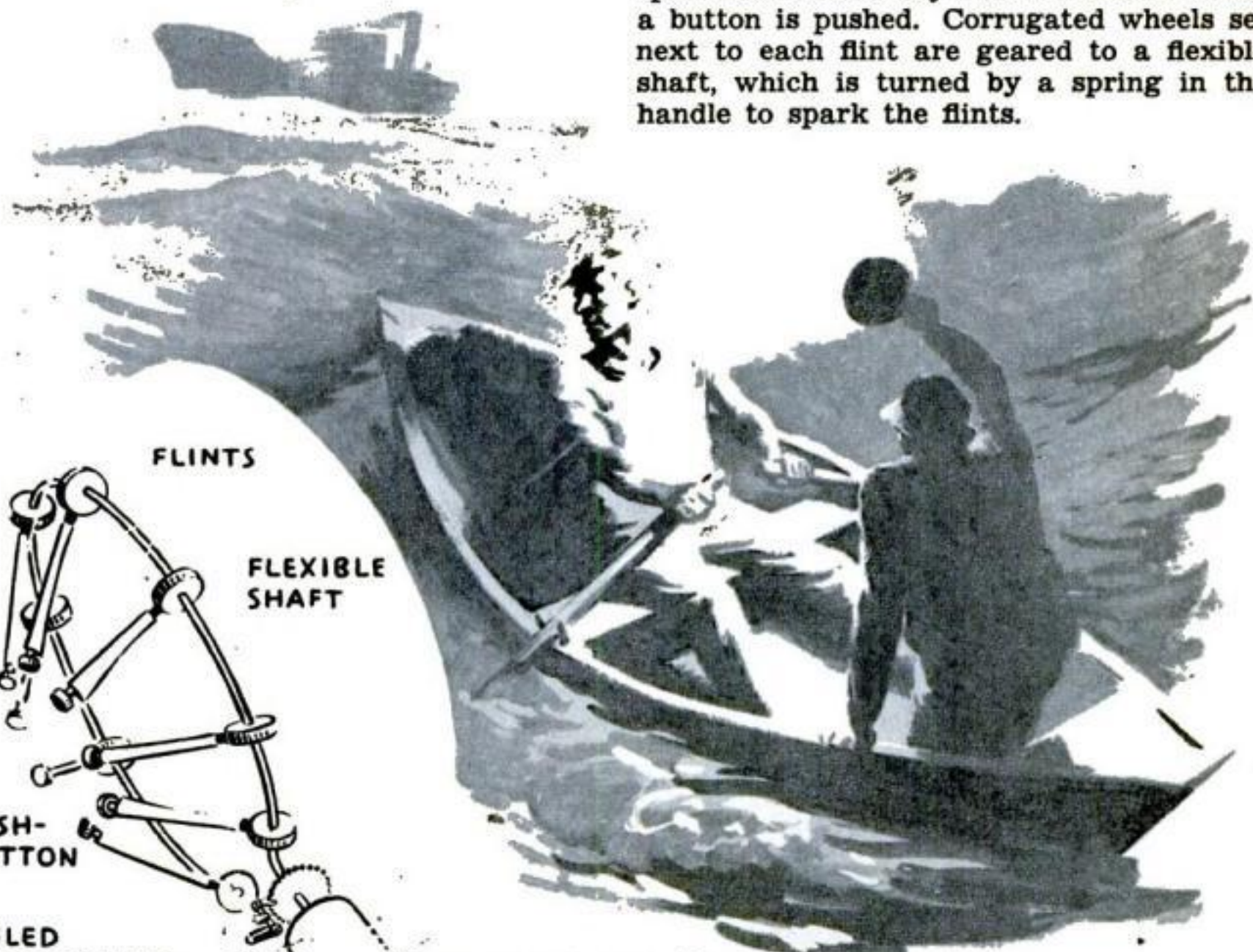
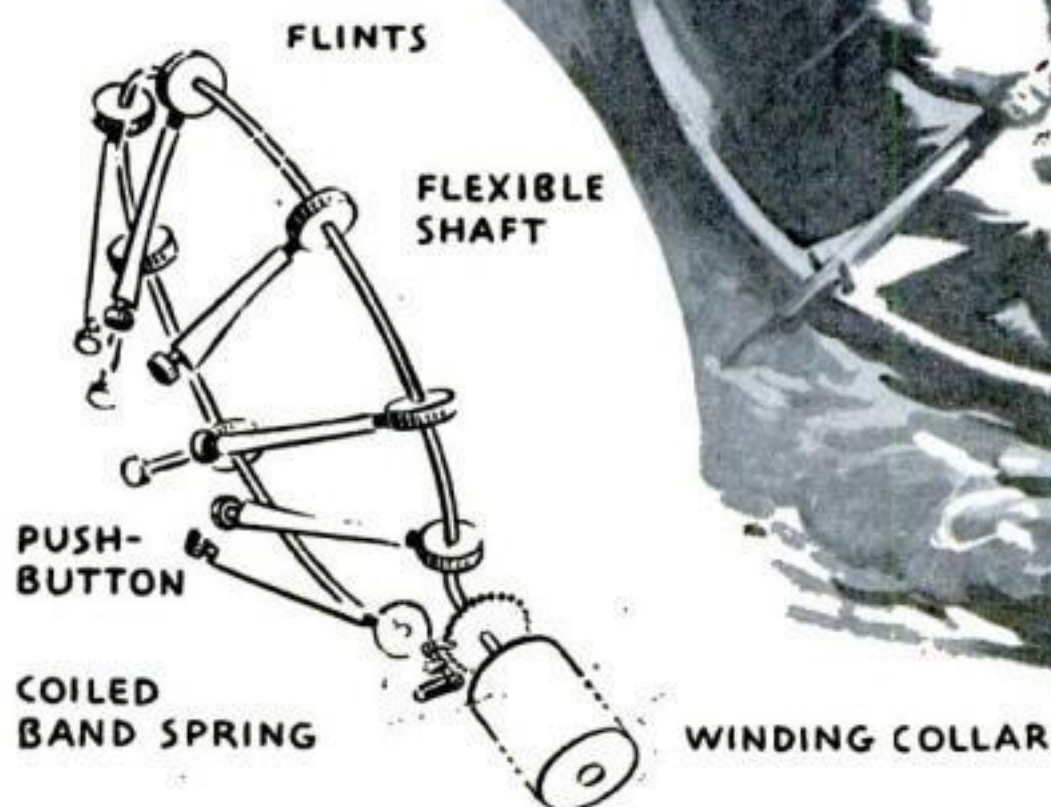


Expansible Suitcase. Added room to cram in an extra pair of shoes without bulging the suitcase is provided in a novel piece of luggage invented by Pearl Frandsen, of New York City. Extra compartments can be bolted to the ends of the suitcase to provide more space. Any of the three sections can also be used individually.



Pocket Toothbrush. A toothbrush as easy to carry as a cigarette lighter is the invention of Marcel Boulicault, of Ladue, Mo. The head folds back into a recess in the handle, connected to a supply of moisture-absorbent and disinfectant material to keep the bristles in proper condition. Dentifrice and dental floss are in a dust-proof cartridge in the handle.

Mechanical Flash Lamp. A signal light needing neither electricity nor fuel has been invented by Robert A. Adams, of Brawley, Calif. Eight flints, set in a circle, spark simultaneously into a reflector when a button is pushed. Corrugated wheels set next to each flint are geared to a flexible shaft, which is turned by a spring in the handle to spark the flints.



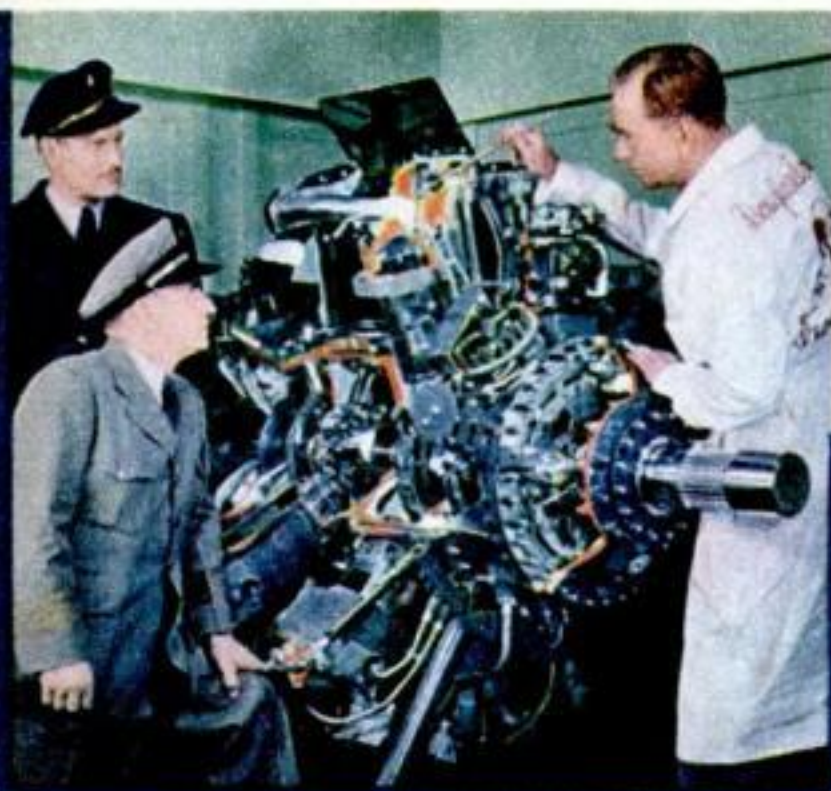


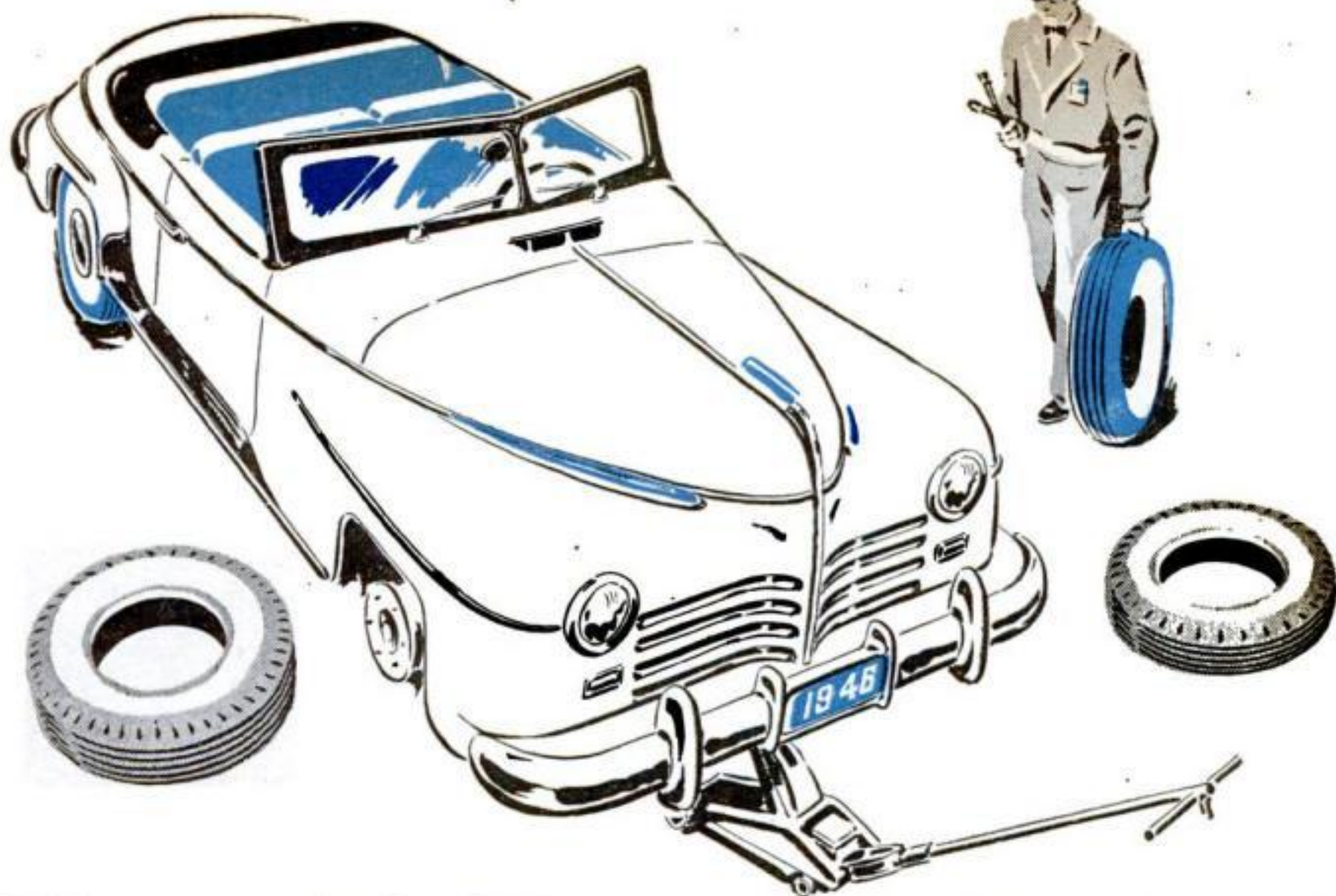
Turret Truck. Something new in equipment for moving factory materials is a truck with its power plant and drive wheel built as a single rotatable unit. The design eliminates the need for a reverse

gear. Power is supplied by a six-horsepower, single-cylinder, air-cooled engine through an automatic transmission and clutch. The truck, a Salsbury Motors, Inc., product, attains a speed of eight miles per hour.

300-M.P.H. Air Liner. Sixty-eight passengers can be carried by day and 26—in berths—by night in the new Douglas

DC-6, a four-engined, 8,400-horsepower transport that cruises at 300 m.p.h. The cabin is pressurized, sound-insulated and air-conditioned. The red on the outboard engines on the plane in the picture below signifies that it is on an experimental flight. More than 150 of these transports have been ordered by domestic and foreign lines. To learn how its engines operate, air-line pilots, shown in the inset, are studying one-half of a Pratt and Whitney R-2800 power unit used on the DC-6.





By GEORGE H. WALTZ, JR.

How GOOD are Synthetic Tires?

Very good—and getting better: they'll be tougher and good-looking, too.

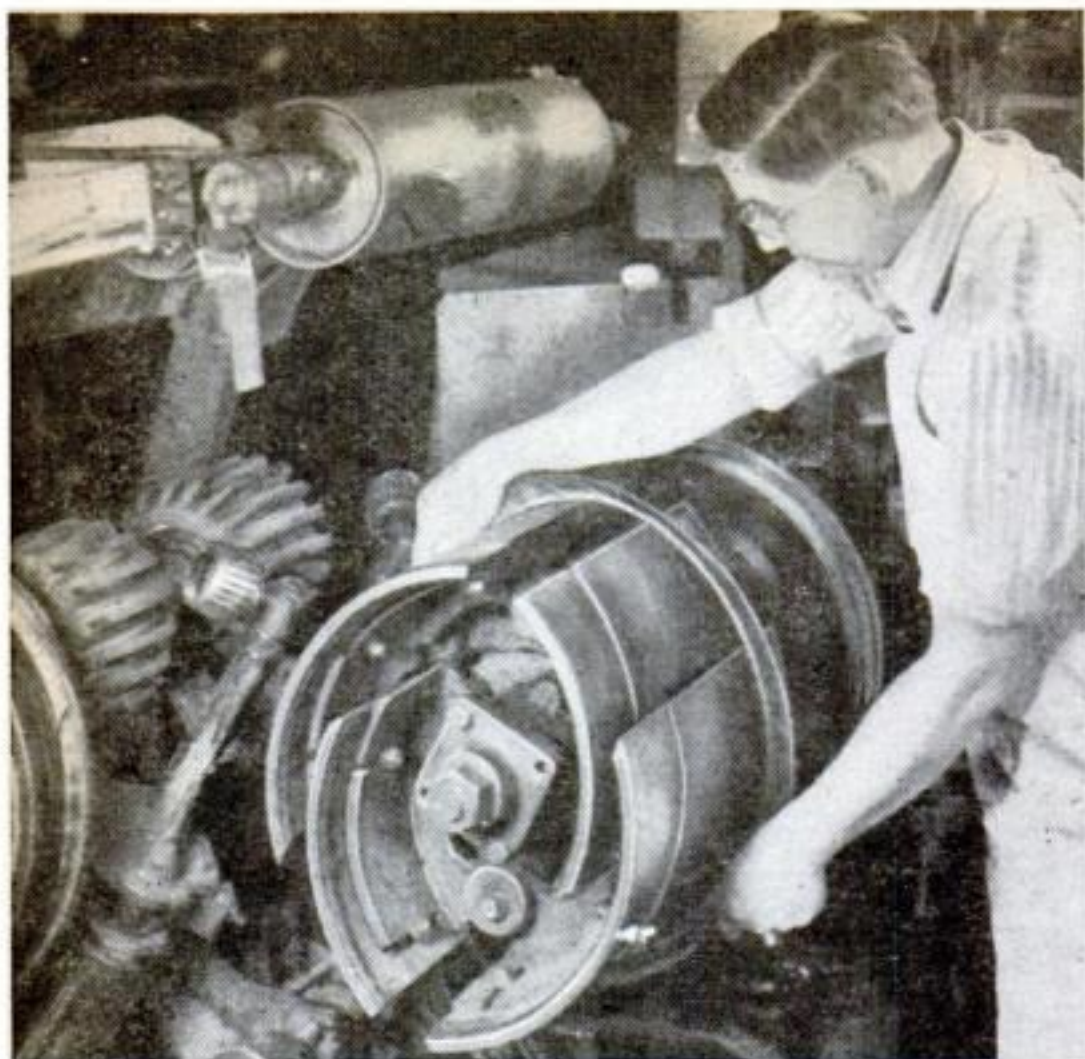
IN LESS than five years you will be able to buy a tire that will go 100,000 miles—much farther than most owners drive their cars. Dr. R. P. Dinsmore, the Goodyear Tire and Rubber Company's vice-president in charge of research, makes this prediction. Improved synthetic rubbers used in smarter ways will make that tire possible.

Our first synthetic tires were poor substitutes for the natural article—they wore out quickly at normal speeds. They cracked, they overheated, they tore apart. But each year brought improvements, and by pooling research efforts the major rubber companies, under the Government Office of Rubber Reserve, soon produced a synthetic tire that would stand up. *Today, severe road tests prove that the modern synthetic tire for passenger cars wears as well or better under normal use than the prewar natural-rubber product.* As for inner tubes, today's synthetic tubes have proved themselves so far superior in some respects that natural-

rubber tubes may never again be produced.

During the war the rubber industry's production problem was one of quantity. Millions of tires were needed by our armed forces and our civilian transportation system. Now, the tire makers can concentrate on quality. Research is progressing in many directions. By using radioactive isotopes in blends of synthetic mixtures, laboratory technicians are seeking particularly to find out more about special-purpose rubbers. With radio-sulphur in place of ordinary sulphur, they hope by the tracer technique (PSM, May '46 p. 91) to solve the secrets of vulcanization processes for both synthetic rubber and natural rubber. By studying the molecular construction of synthetic rubber, they hope to learn why it has a tendency to heat up more than natural rubber when it is flexed.

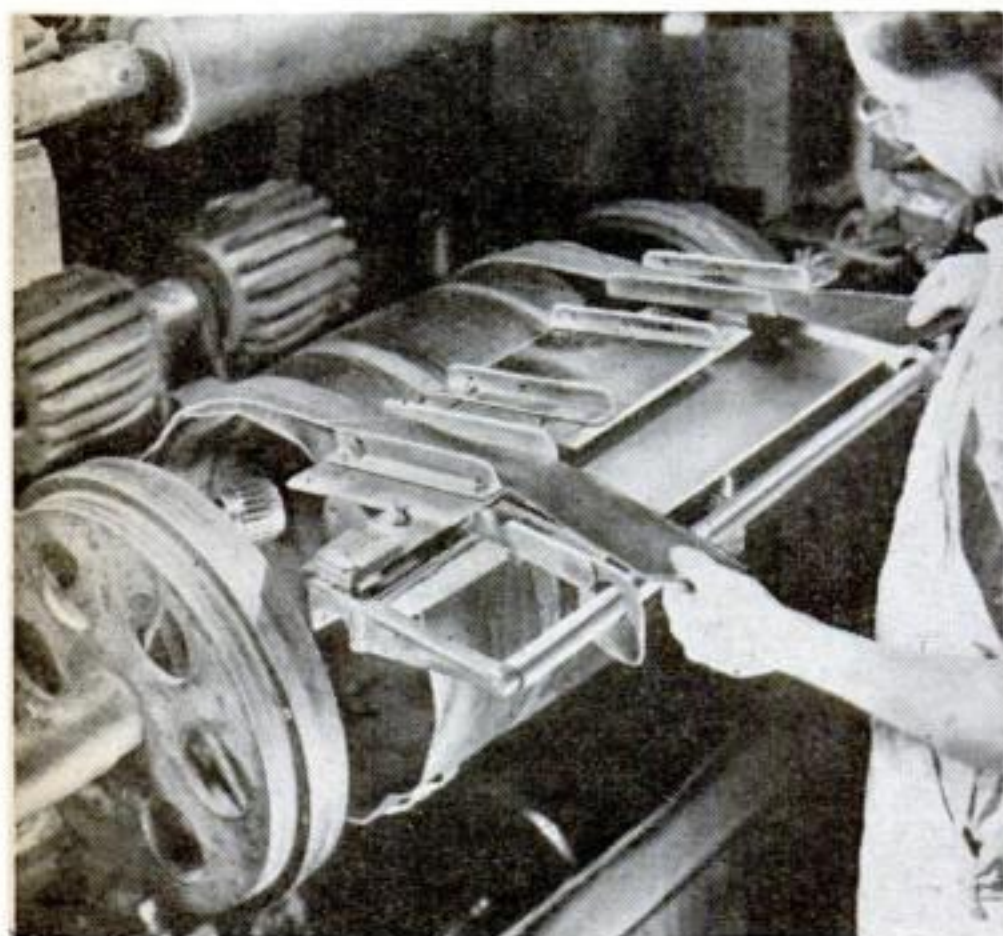
One of the biggest pieces of research news to come from the rubber laboratories recently is "white" carbon black. For 35



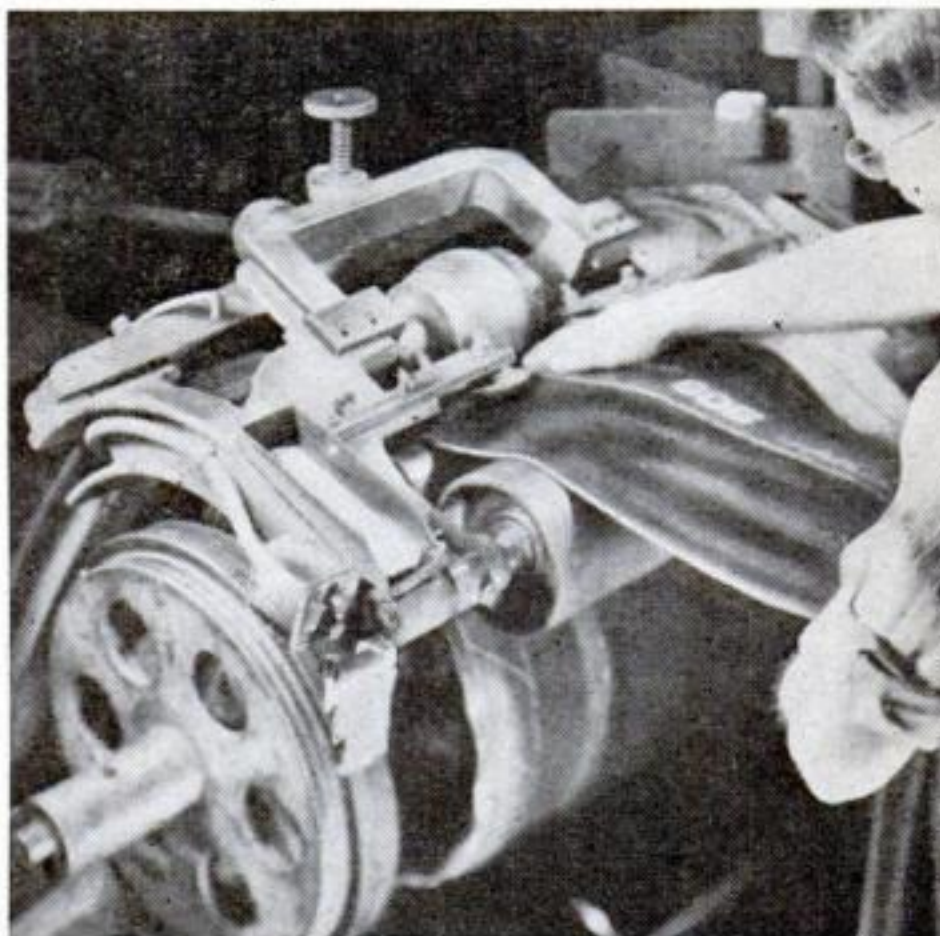
1. First step in making a 6.00-16, four-ply tire with new semiautomatic machines is to place inside beads over collapsed drum, which is then expanded.



2. As the drum rotates, tire builder lays on first of fabric plies, cut on proper angle. This method assures uniform product, lessens emphasis on skill.



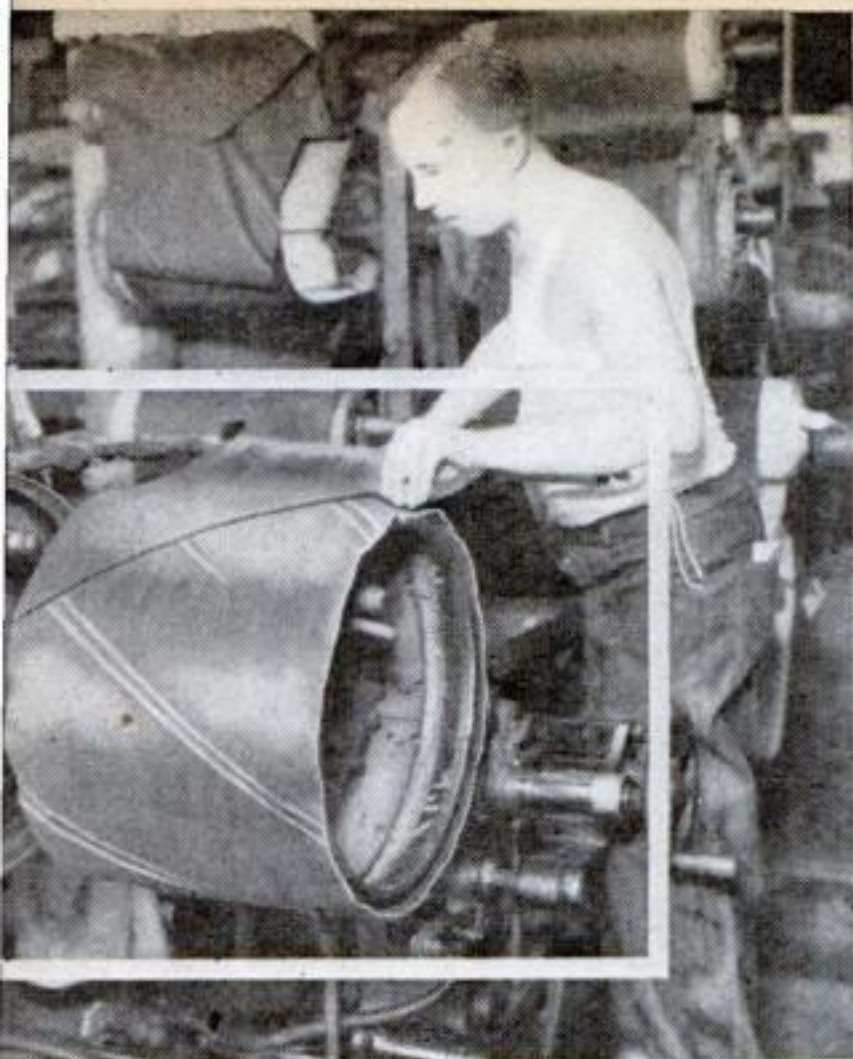
4. When final plies and a breaker strip have been added to the tire structure, strips of fabric known as "chafers" are applied. These are to keep beads of the finished tire from chafing against wheel rim.



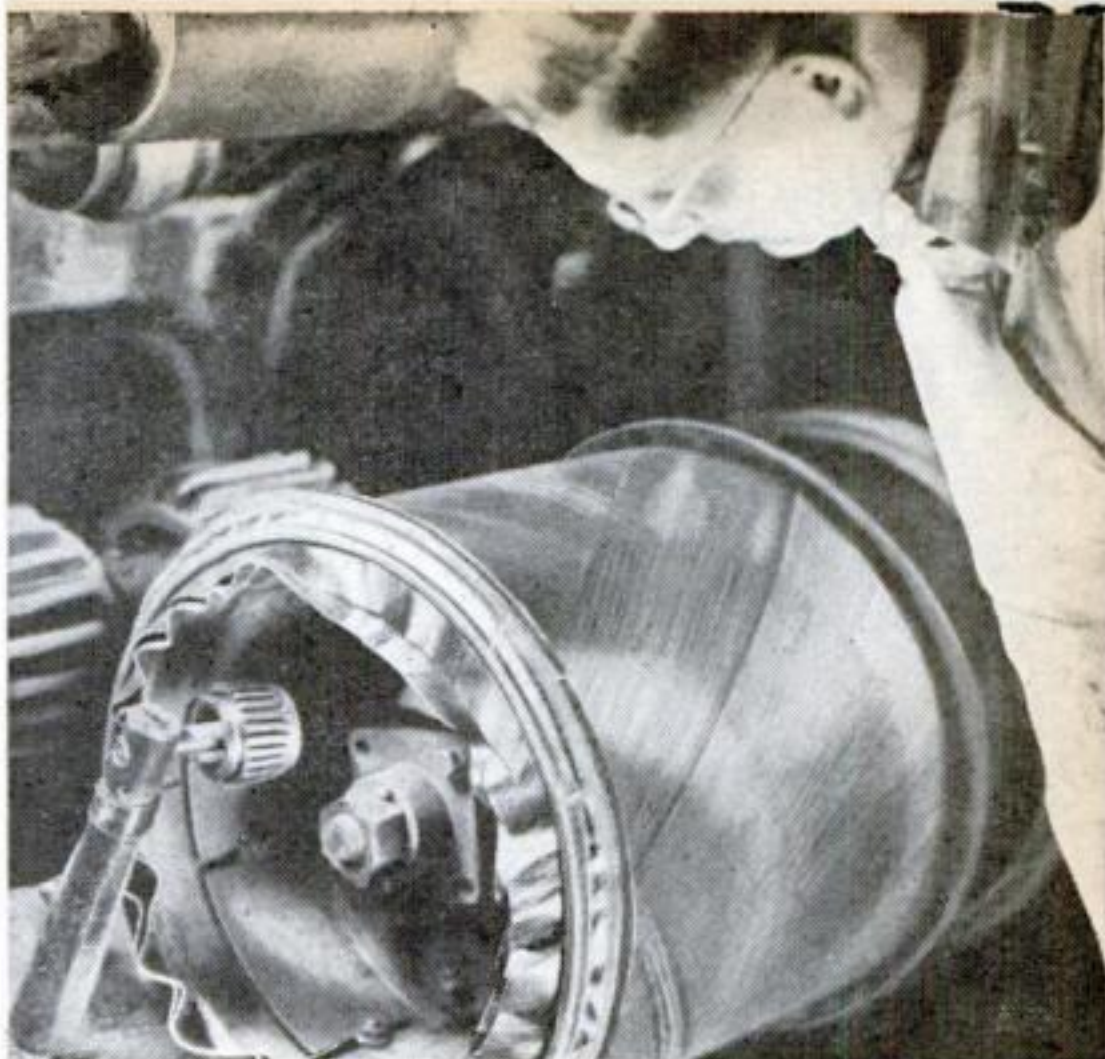
5. In applying tread, upon which the design appears after tire is bagged and cured, the operator merely guides material; as in other steps, machine supplies precision, this time with a tread roller.

years tire builders have used carbon black—ordinary black soot—as a binder to give added tear resistance, abrasion resistance, and tensile strength. This meant that all strong rubber had to be black. To build whitewall tires, strips of weaker white rubber had to be bonded to the outer wall of the black casing. With "white" carbon black, pure white—or even baby blue, orchid, or

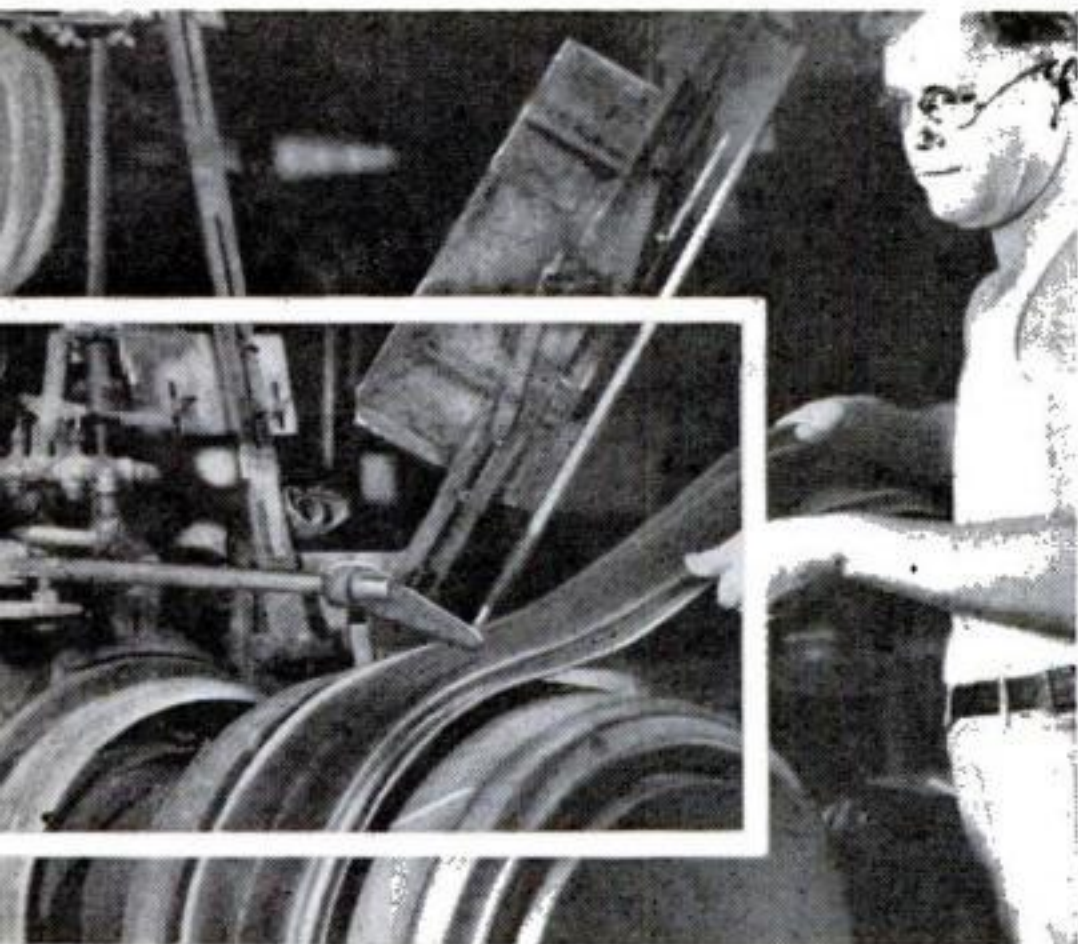
almost any shade to suit the color of your car—can be made with all the strength and wearing properties of black rubber. "White" carbon black, a development of B. F. Goodrich Company, is made from an easily obtained natural source—white sand. Ethyl silicate, a highly volatile liquid obtained from sand and alcohol, is burned and white soot results.



For contrast, here is the prewar system of laying on plies. With such machinery, finished product's quality depended largely on dexterity of operator.



3. After beads are set by the machine, automatic stitchers come into position to make a turn-up of the first two plies, securely wrapping the beads.



The old method of putting on a tread. Here again, besides being slower, the machinery allowed greater chances of human error and put most of the responsibility for quality on the operator.



6. Looking like a barrel with both ends removed, tire is taken off the collapsed drum. Operator gives it a quick check before placing it on conveyor to go to inspection station. (Goodyear photos.)

Research has also improved tire manufacturing methods. Before the war, the building of a tire was primarily a hand operation. Much depended on the skill and dexterity of the individual worker. Now semiautomatic machines controlled by a network of photoelectric cells and electronic tubes turn out uniform tires more than 50 percent faster than the older methods.

Even when we again can get all the crude rubber we want from the East Indies—a matter of 12 to 18 months—synthetic rubber will probably still be used to make a lot of passenger-car tires. First, the current high price of 23½ cents a pound for crude rubber, as against 18½ and possibly 15 cents for synthetics, favors synthetic rubber. The average automobile tire uses about 11

pounds of rubber, so the raw-material cost for natural rubber would be at least 55 cents more. Second, rubber experts have tremendous faith in future synthetic developments. And we have a \$750,000,000 investment in Government-owned synthetic rubber factories.

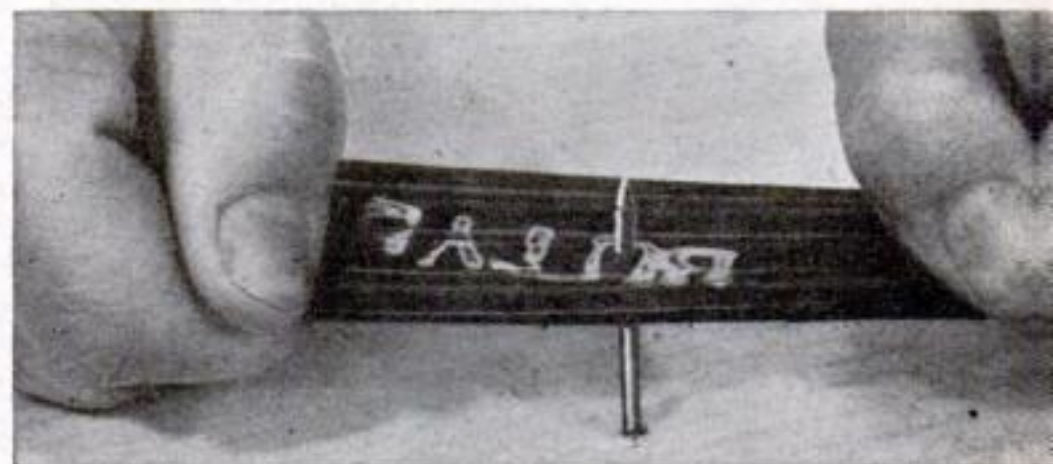
At present, as during the war, we are producing four principal types of man-made rubber: GR-S (Government Rubber-Styrene); GR-I, or butyl rubber; GR-M, or neoprene, and GR-A, or buna-N.

GR-S is the standard bulk, general-purpose synthetic rubber for tire casings, shoe soles and heels, rubber boots and mechanical goods. More of it is made than any other synthetic rubber. It is doing a good job of filling our needs, but rubber technologists are by no means convinced that it is the ultimate. They feel that research eventually will come up with a man-made rubber that not only will be "just as good or better" but will far surpass nature's product.

In a single laboratory maintained by the Office of Rubber Reserve at the University of Illinois, at least 50 new types of synthetic rubber have been produced. One of these, called sodium rubber, shows promise in laboratory tests of being a better general-pur-



Why butyl tubes are better: Natural rubber, above, tends to tear if punctured. Butyl, below, does not tear and actually clings to nail. A 90-mile test run with identical nail-pierced tires left a natural tube flat while its butyl rival still had 25 pounds' pressure, 10 pounds of which it held for 12 hours.



pose product than GR-S, particularly in its resistance to overheating and cracking—important in the manufacture of tires. Enough of this new sodium rubber has been pro-



A comparative air-diffusion test shows why pre-war tubes needed air every two weeks while butyl tubes require attention only three or four times a year. Tire with natural tube, above, lost seven pounds' pressure in three weeks; butyl



tube, below, lost none. Butyl's superiority is important because a four-pound pressure drop, particularly in synthetic casings, cuts tire life more than 15 percent, boosts gasoline consumption by one gallon in 12. (U. S. Rubber Co. photos)



duced experimentally for use in a test tire. GR-I, or butyl rubber, is the one that gives us our better-than-natural rubber tire tubes. Butyl inner tubes have proved far more durable than those of the natural product. Once inflated, they hold air 10 times better than a natural-rubber tube, and they perform much better after being punctured.

Our two other synthetic rubbers—GR-M and GR-A—both have proved excellent for specific purposes, in which they out-perform natural rubber. GR-M's superior properties are its resistance to chemicals, oil, heat, air, light and flame, making it valuable in the production of oil-resistant hose, electrical insulation, gaskets, aviation gasoline tanks and belting. GR-A, both oil and cold-resistant, is a perfect material for self-sealing fuel hose and fuel tanks for airplanes, oil-proof and coldproof fabrics, and as a binder for abrasive wheels. These two synthetics perform jobs that natural rubber could not do.

The end of the war brought no lull in synthetic production. On the contrary, 1946 will be the biggest production year in the history of the industry. By year's end we will have used approximately 1,000,000 long tons of rubber (a long ton equals 2,240 pounds), over 70 percent of it synthetic. In 1940, the record prewar year, the total was 651,000 tons, of which only 2,500 tons

were synthetic. In 1947, with more natural rubber available, the balance is expected to level off to a 50-50 percentage.

One plan in the minds of tire builders is a combination of synthetic and natural rubbers to produce a supertire that will be superior to one made wholly of either. Each product would be used as an independent building material—natural rubber in the spots where it does the best job, synthetic at the points where it excels.

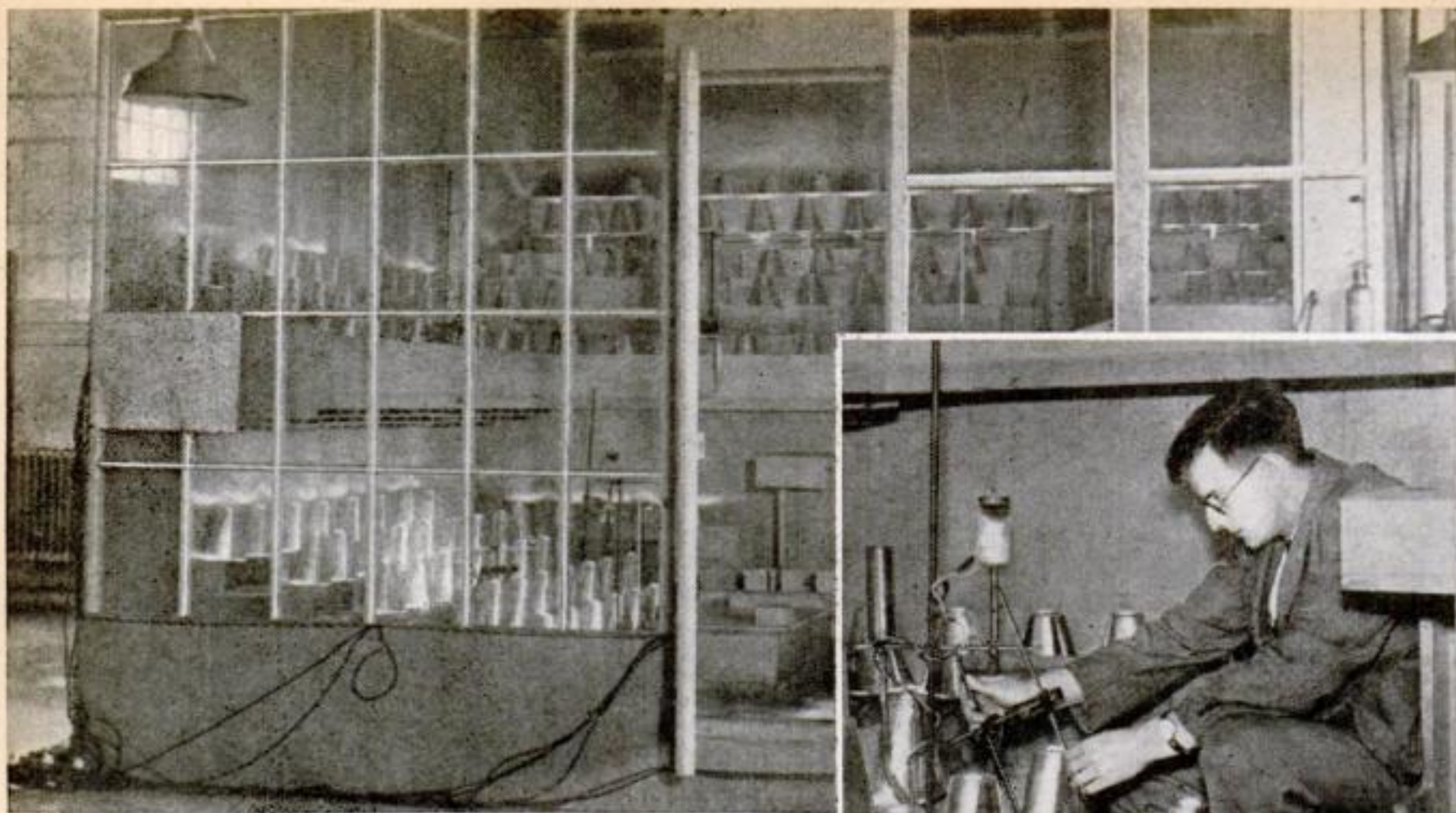
The rubber industry's research chemists today have two main goals: to produce a synthetic rubber that can be tailor-made to fill every need, and someday actually to synthesize natural rubber from chemicals.

In the offices of each of the major rubber companies stands a row of half a dozen or more three-drawer metal filing cabinets. These contain the thousands of reports issued by the Office of Rubber Reserve outlining the results of all experiments and tests made by the Government and the rubber companies since the start of the war. According to Dr. Waldo L. Semon, famous rubber technician and director of research of the B. F. Goodrich Company, "Those files may well contain the hint that will lead to a synthetic rubber better than natural rubber or any man-made substitute so far known."

Perhaps even a tire that will last as long as the car is not too much to expect. **END**

A One-Minute Primer of Synthetics

TYPE	MAIN INGREDIENTS	MAIN USES
GR-S (BUNA-S)	Petroleum or Alcohol (Butadiene) and Coke (Styrene)	Tire Casings (As good as natural for passenger-car tires)
GR-I (BUTYL)	Petroleum	Inner Tubes (better than natural)
GR-M (NEOPRENE)	Acetylene, Salt, and Sulphuric Acid	Heat-, Oil-, and Flame- Resistant Rubbers (better than natural)
GR-A (BUNA-N)	Crude Oil or Alcohol (Butadiene) and Acrylonitrile	Oil- and Cold-Resistant Rubbers (better than natural)



BETTER AIR FOR COMMONS. The British National Physics Laboratory has built a model of half of a proposed debating chamber (above) for the new House of Commons to test the ventilation system. Each conelike lamp on the benches emits the body heat of two persons. The air inlet can be seen at left under the gallery. Inset: A physicist checks the temperature of a lamp.



WEAPON AGAINST POLIO. A "baby lung" that can replace an iron lung in polio cases has been devised by the AAF Aero Medical Laboratory. Originally built to combat oxygen deficiency among air crews, it provides intermittent oxygen pressure.

GLASS in the Atomic Age

World's oldest plastic will
shield health and machines.



Here a soldier of some unwanted future day enters an atom-bombed area wearing an artist's concept of uranium-glass clothing and respirator. Even ground under his feet would be a peril, as evidenced by cloudy photo of a key, above. It was made by radioactivity of sand fused in Alamogordo blast.



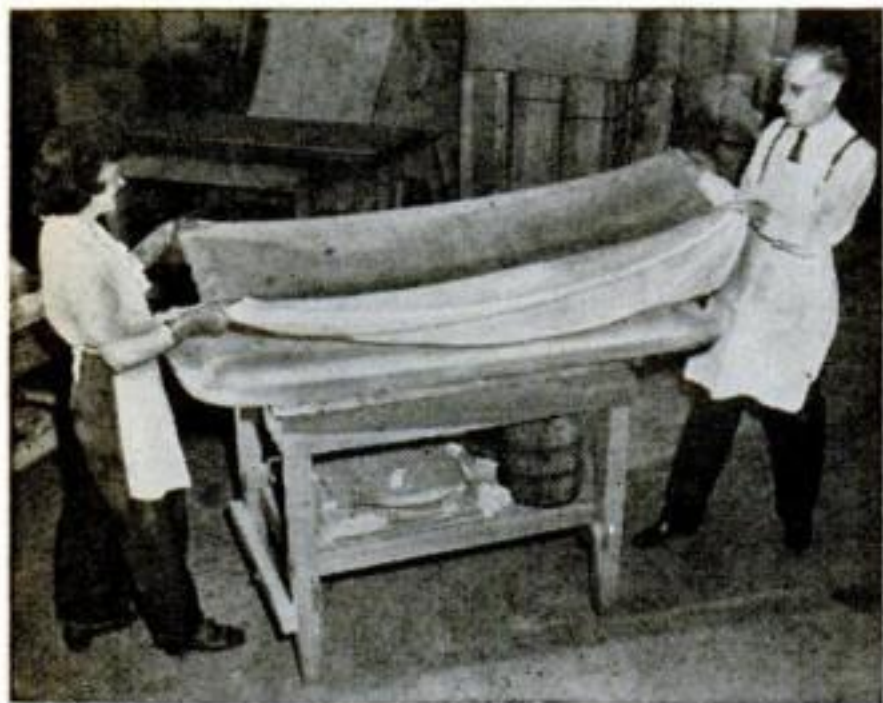
THE PET idea of self-styled camouflage experts early in the war was to build warplanes of glass so that they could not be seen. Glass airplanes never flew, but glass is being used, because of its strength, in airplanes, artificial arms and legs, bullet-proof armor, arctic clothing, boats and canoes, fertilizer, surgical bandages and fillings for teeth. One large glass company now is producing glass in more than 4,000 different forms and has experimental projects covering some 300 more potential uses.

The world has passed progressively through a Stone Age, a Bronze Age and a Steel Age. Glass experts believe that we now are entering a Glass Age.

A major glass-research program at the University of Pittsburgh, directed by Dr. Alexander Silverman, head of the University's chemistry department, is aimed at the solution of some of the age-old secrets of

glass. By using radio-isotopes as tracers, Dr. Silverman hopes to find out how the raw materials in glass melt, how the glass flows during melting—and what causes defects in glass. His findings may take many of the "ifs" out of glass manufacturing and open important new fields for future research regarding the world's oldest plastic.

A firm believer in a Glass Age, Dr. Silverman foresees great advances within five years. One of his most spectacular prophe-



1. Illustrative of the many new uses of glass is the making of molds that permit electronic vulcanization of sponge-rubber auto seat cushions. First step is to place glass-cloth layers on wood form.

cies is that glass will be used as a defense against the atomic bomb. The same element that is used to make the bomb—uranium—can be used to produce a glass that provides good protection against harmful radiations. Garments and helmets made of cloth spun from uranium-glass or lead-glass fibers, says Dr. Silverman, would permit safe entry into atom-bombed areas. Special oxygen respirators, equipped with glass-insulated high-frequency precipitators, would keep radioactive dust out of lungs of rescue workers.

One of the most important recent glass-fiber developments is the perfection of a method for reinforcing other plastics with glass, just as we reinforce concrete with steel rods. Glass-reinforced plastics have many metal-like qualities, yet can be fabricated easily and inexpensively without complicated dies or high-powered presses. Almost as light as aluminum, they have the strength of many of our stronger structural metals. Designers and engineers are finding them ideal for use in molding railroad-car, bus and automobile bodies, airplane fuse-

lages and parts, boats and canoes, fishing rods, luggage, football helmets, artificial arms and legs, furniture, kitchen and bathroom assemblies and home appliances.

Fabricating a glass-reinforced plastic product is like making a layer cake or using a pressure cooker, and almost as simple. The process is similar to that used in making low-pressure laminated plastics, except that glass cloth is used in place of plywood, sisal or paper as the filling for the plastic sandwich (PSM, May '46, p. 122). Successive layers of glass-fiber cloth, impregnated with the desired liquid plastic, are simply laid one on top of the other in a form,



2. When enough of the resin-impregnated layers have been applied, the mold is put in a rubber bag for curing. Fiberglass materials, used in this process, meet all the varied demands of electronic heating.

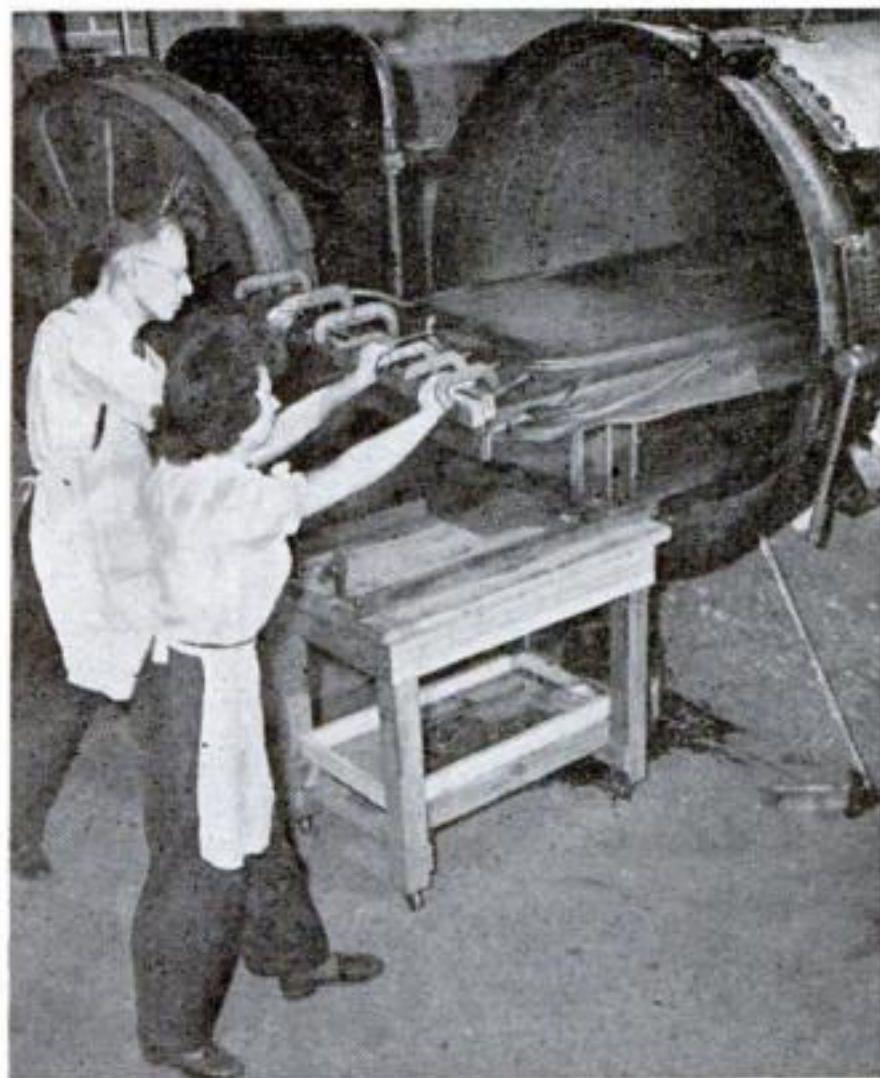
or mold, of the desired shape. When enough layers have been built up to obtain the required thickness and strength, heat and pressure are applied in an autoclave that resembles a giant pressure cooker.

Technologists are devising all sorts of new uses for glass cloth and glass fibers. The same qualities that have made glass cloth valuable as heat-insulating material for use in buildings, bus tops and airplane cabins are now being put to use in new arctic clothing being tested by the U. S. Army. Field jackets, parkas, boots and mittens lined with glass cloth are expected to give good lightweight protection against subzero temperatures. An experimental glass-cloth-lined parka, worn by an observer during the recent Operation Musk Ox in northern Canada, afforded complete comfort at temperatures as low as -40 degrees F.

Glass-reinforced plastics also have made possible a lightweight bulletproof body ar-

mor for soldiers, which surpasses metallic armor in ballistic efficiency. Doron, as the glass-plastic armor is called, will stop missiles up to and including a .45-caliber revolver bullet. At the moment, Doron-armored jackets are undergoing rigid tests in the jungles of Colombia. Eighteen jackets have been supplied to American scientists and drill crews of an oil company, several of whose employees have been wounded by natives.

Other experiments under way include the use of milled glass fibers as a reinforcing



3. The mold, inside its rubber container, is then put in an autoclave, an oven providing temperatures of 280 degrees F., pressures of 63 lbs per sq. in.



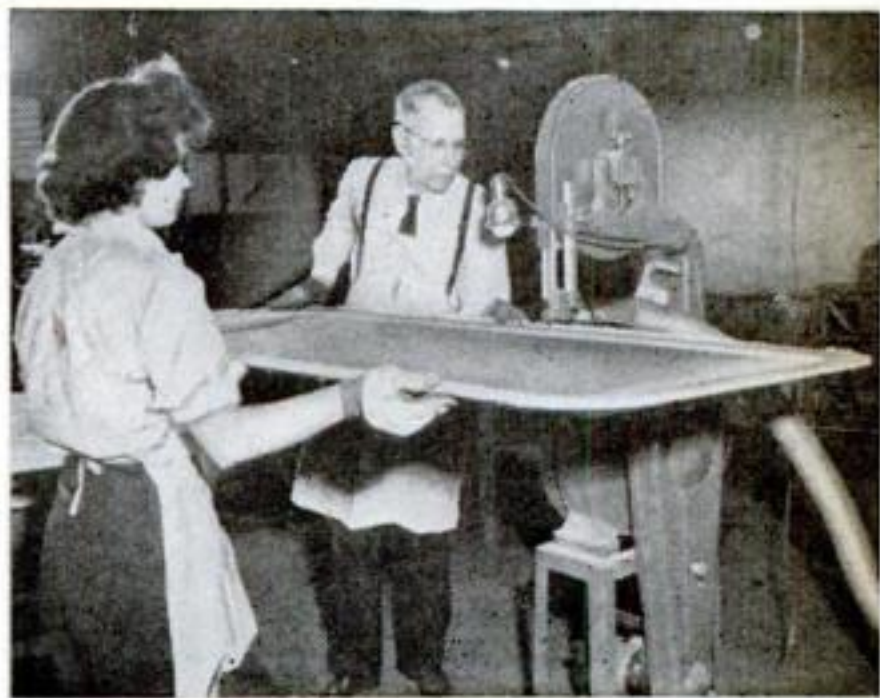
4. After curing, the glass-cloth mold is removed from the autoclave, taken off its wooden form, and finished with a coat of thermosetting varnish.

agent for special papers, as a material for strengthening phonograph records, and as an ingredient of paint to improve its sound-deadening qualities. It is even being used in yarn form by dentists to fill the root canals of teeth. Surgeons also are turning to glass yarn and cloth for sutures, special bandages and filters for blood plasma.

In the future it may even be possible to fertilize your garden by sprinkling the ground with glass wool. In an experimental process being developed by Drs. Alfred E. Badger and Roger H. Bray at the University of Illinois, a special glass containing the principal plant foods is so mixed that it is soluble in water and dissolves slowly in the soil, giving off chemicals necessary for plant life. By altering the composition of the glass, the rate at which it dissolves can be controlled. In this way, one application of the glass fertilizer can be made to serve over a period of several years.

Science has not only learned how to do new things with new glass, but it has learned how, by the use of special coatings, to improve the older conventional forms of glass. One is the new transparent and durable electricity-conducting coating that can be applied to windshields of airplanes and automobiles to eliminate the dangers of icing and fogging (PSM, Oct. '46, p. 92).

Uncle Sam now leads the world in glass technology. Even in the field of optical glass, long dominated by Germany, we now excel, according to the Bureau of Standards. As research continues, the miracle of glass will continue to unfold. Glass as a material is thousands of years old. But glass as an industry is just coming of age. **END**

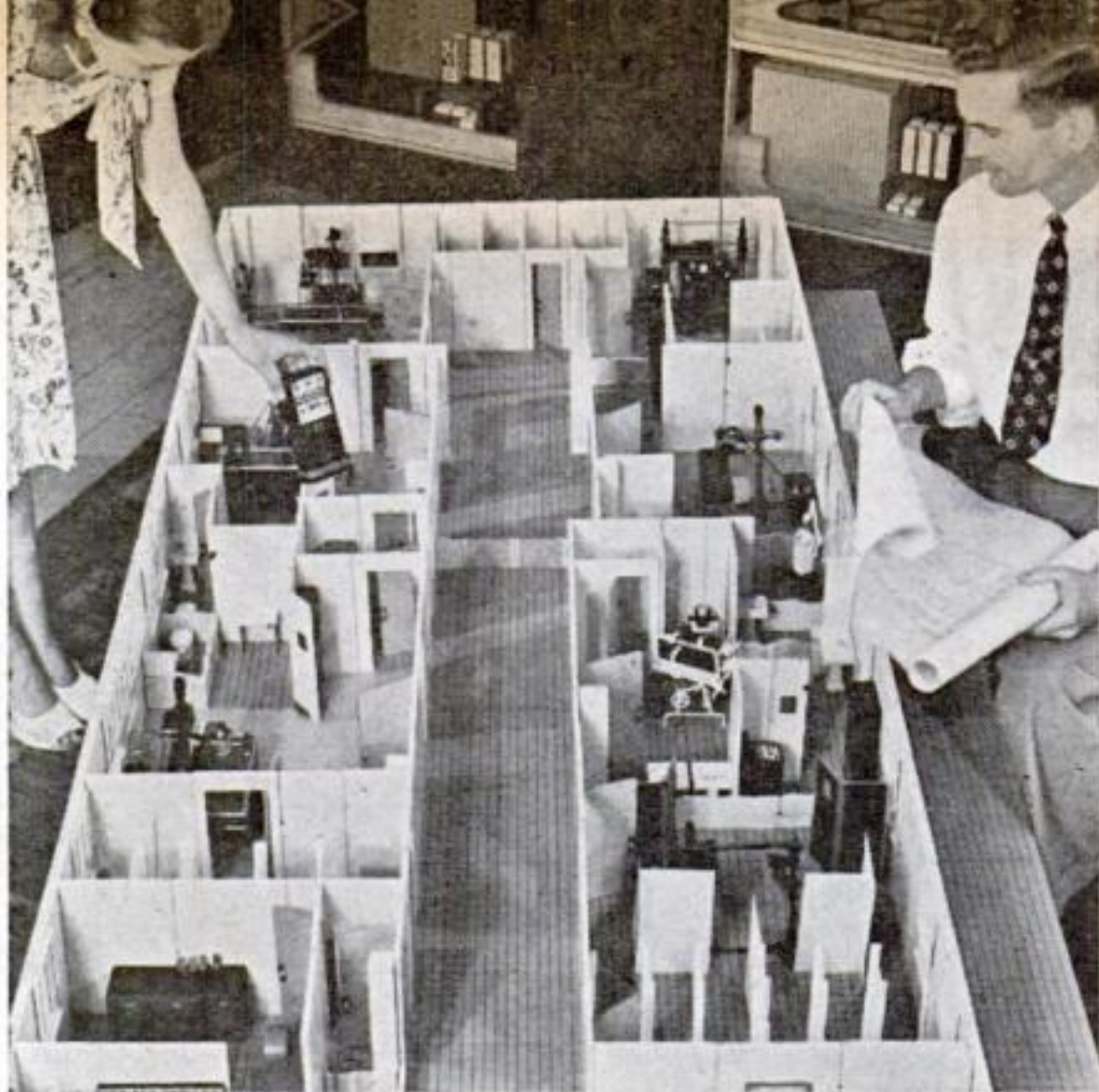


5. Edges of the mold are trimmed, just as metal would be handled, in the final step. Molds like this speed rubber processing as much as 90 percent.

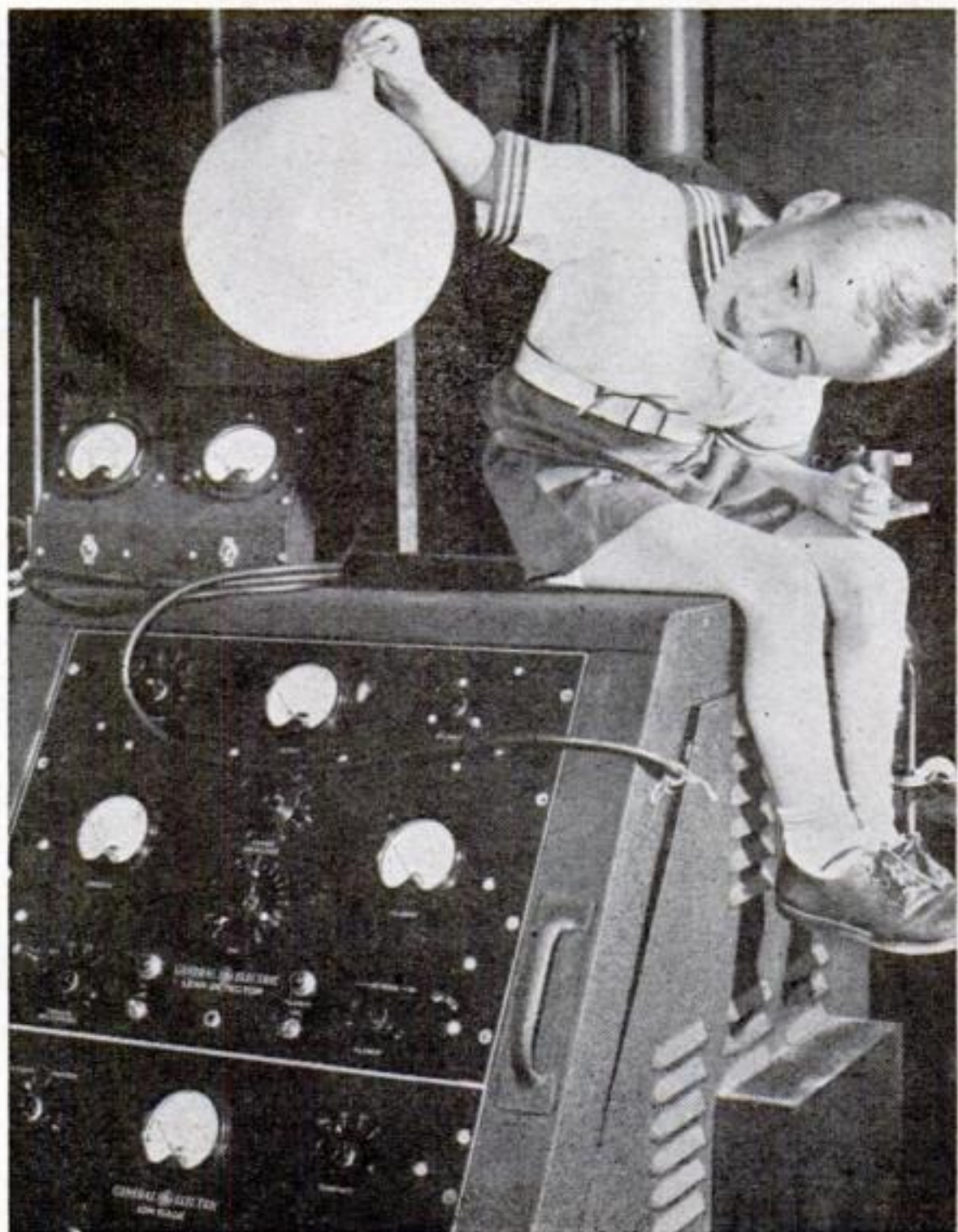
X-Ray Model. This replica of a hospital wing (right) helps Westinghouse plan replacement of X-ray facilities worn out during the war. Such three-dimensional models replace blueprints.



Mine Dress. For miners' safety, the U. S. Bureau of Mines recommends the outfit above. It includes shoes with reinforced toes, coveralls tied at the ankle, a feather-light dust mask, shatter-proof eyeglasses and a helmet that withstands a 500-pound blow. The respirator at the belt allows normal breathing for an hour if a miner is cut off from air.



Leak Detector. A leak detector that can spot a leak small enough to let only a gallon of air out of a container in 60,000 years has been perfected by General Electric. The lad below is trying it on his balloon. The detector tests electronic tubes for vacuum tightness.





Dr. August Raspet, inventor of microbarograph.

Soaring with a Buzzard

GLIDER pilots know that one sure way to locate a rising current of warm air is to find the nearest buzzard and then fly formation with it. The buzzard, an ace among soarers, always knows where the invisible thermals are.

To learn how buzzards know where to fly, Dr. August Raspet, of Locust Valley, L. I., the Soaring Society of America's research director, has invented a one-ounce barograph. The barograph, two inches long and one inch wide, will be strapped to a tame buzzard's breast and will record altitude variations as far up as 3,000 feet.

Like the two-to-three-pound barographs that gliders and P-61s carried into thunderstorms over Florida last summer (PSM, Oct. '46, p. 94), Dr. Raspet's model is an aneroid barometer. Changes in pressure (the result of altitude variations) move a stylus over the smoked rim of a recorder drum driven by a wrist-watch mechanism.

When the buzzard soars with its meter, Dr. Raspet will get an accurate picture of "thermal microstructure"—the composition of individual warm-air currents.

A buzzard named Fritz was ready to wear Dr. Raspet's microbarograph but died from swallowing a bone before the instrument was completed. George F. Carter, of Kendallville, Ind., captured the bird when it was only a few weeks old. He kept it in his cellar until its wing span reached five and a half feet.

When the captive buzzard first took to the air it was unaware of the effects of wind on flight. It tried to land downwind on a telephone-pole crossbar and ended up hanging by its claws, flapping furiously. The buzzard knew nothing about soaring, either, until one day it blundered into the traffic pattern of some wild buzzards and learned about thermals from them.

Carter is hunting another fledgling that he can train to wear Dr. Raspet's barograph. He even hopes to teach it to fly in a wind tunnel where, by inclining the tunnel and regulating the flow of the air stream, the buzzard's sinking speed can be calculated. Then the bird's flight can be followed through a theodolite and the vertical velocity of a thermal can be measured exactly.

How NYLON Yarn is Made

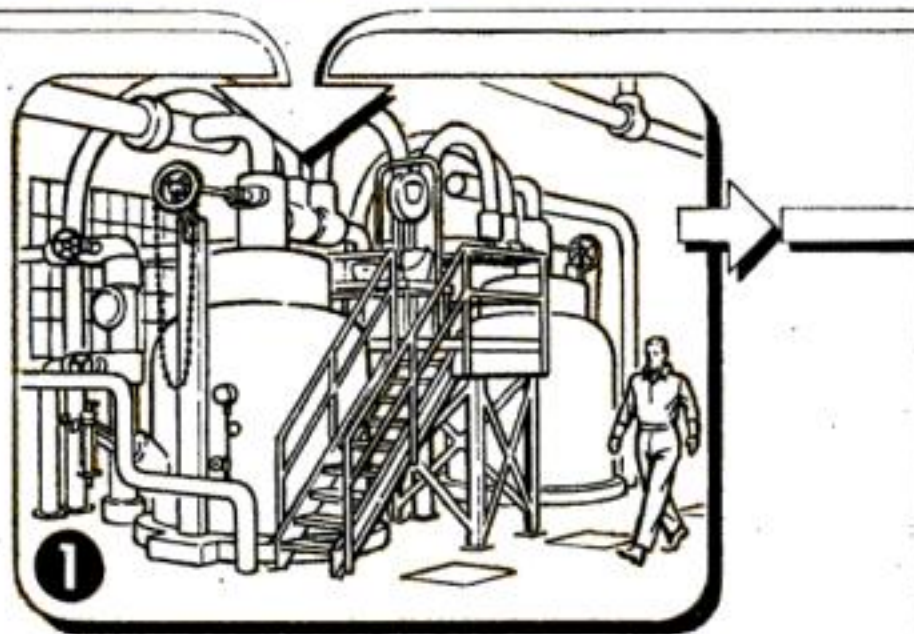
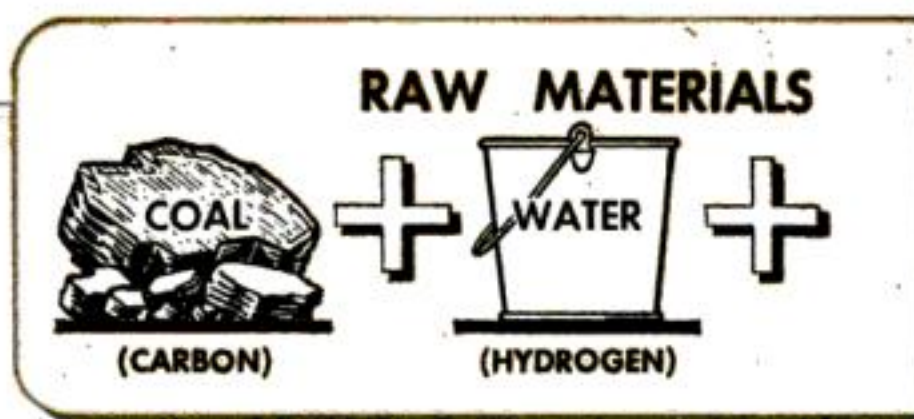


This photomicrograph, taken at a magnification of 660, shows the cross section of a nylon thread. The 17 filaments form a strand used in sheer stockings.

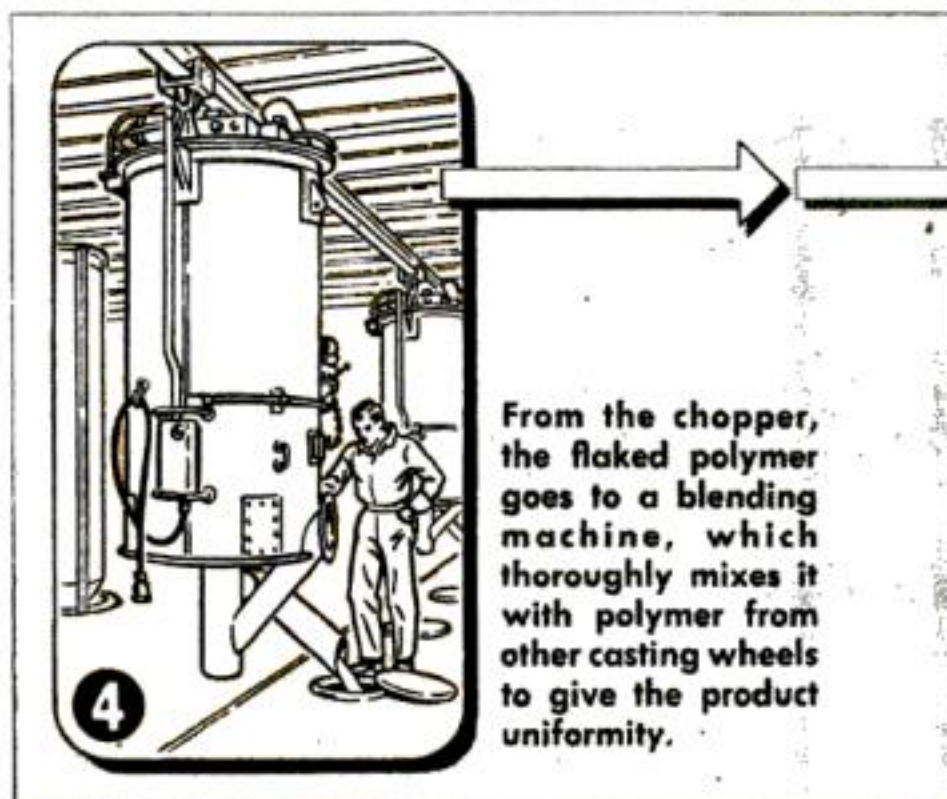
NYLON, silk's young but overwhelming rival, is spun out of air, water and coal. The drawings at the right take the raw materials through the process that chemists worked out in the 1930s to produce the tough, lustrous thread.

About 90 percent of this yarn is used today in the manufacture of women's stockings. The first nylon hosiery appeared in the stores on May 15, 1940; to date, the supply has never equaled the demand. During the war all nylon yarn was allocated to the armed services, largely for use in the manufacture of parachutes. Du Pont now plans to deliver up to 23,000,000 pounds of the thread annually, enough to make 450,000,000 pairs of women's stockings.

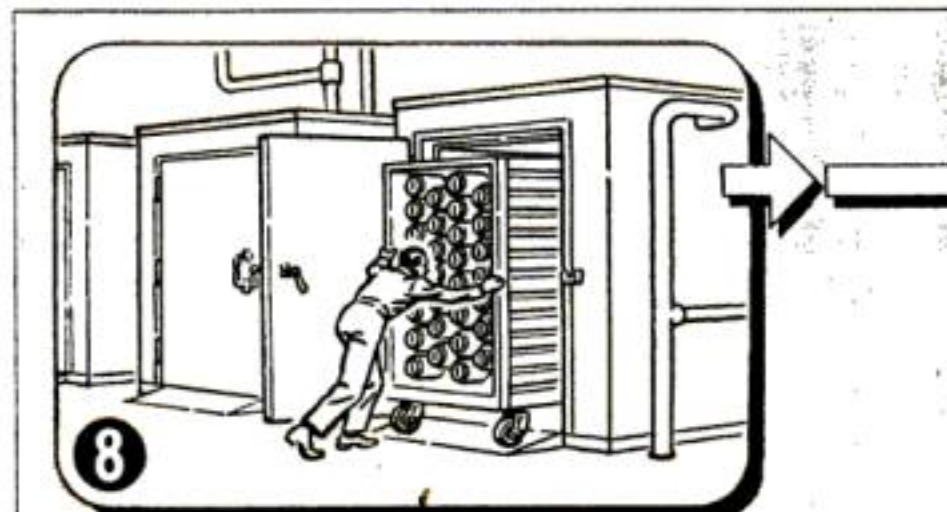
As many as 32 pairs of nylon stockings are knit simultaneously on machines 40 feet long. Gauge, or sheerness, is determined by the number of needles per inch and a half on the knitting needle bar—51 needles make a 51-gauge stocking.



In these great vessels the nylon salt solution, composed of coal, air and water, is evaporated until almost all of the moisture has been removed.

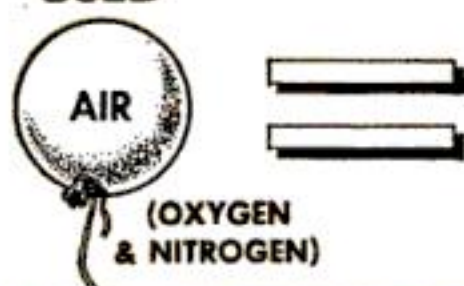


From the chopper, the flaked polymer goes to a blending machine, which thoroughly mixes it with polymer from other casting wheels to give the product uniformity.

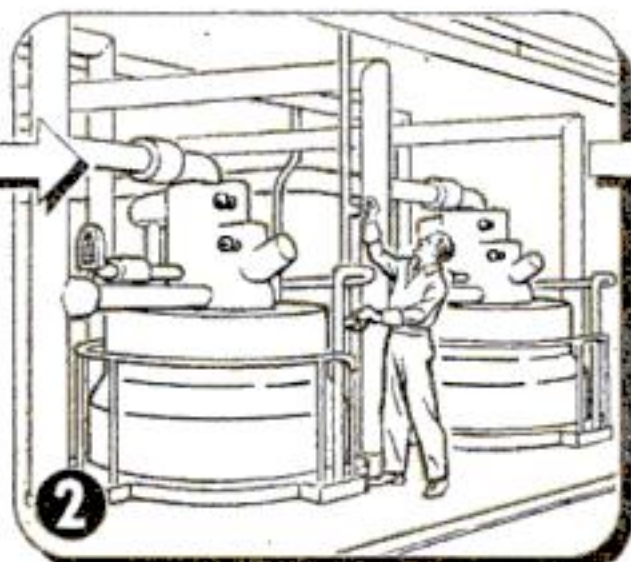
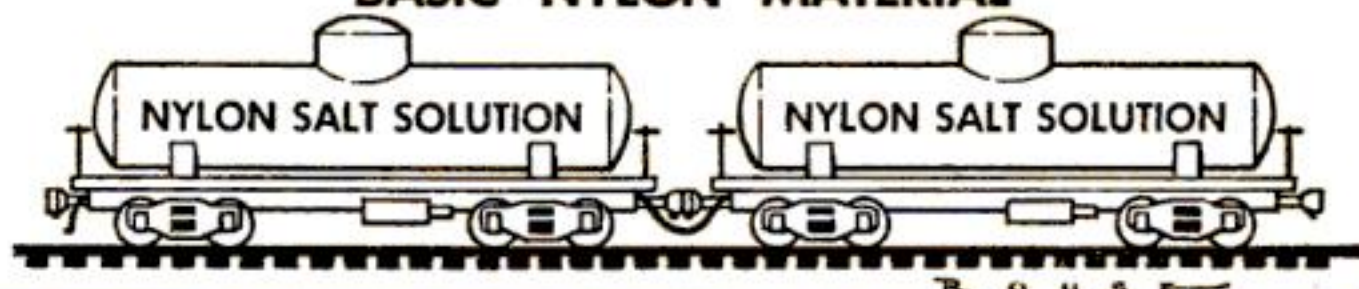


Bobbins are put into trucks and baked in the nylon yarn "twist-setting" ovens before the yarn is wound on spools and cones.

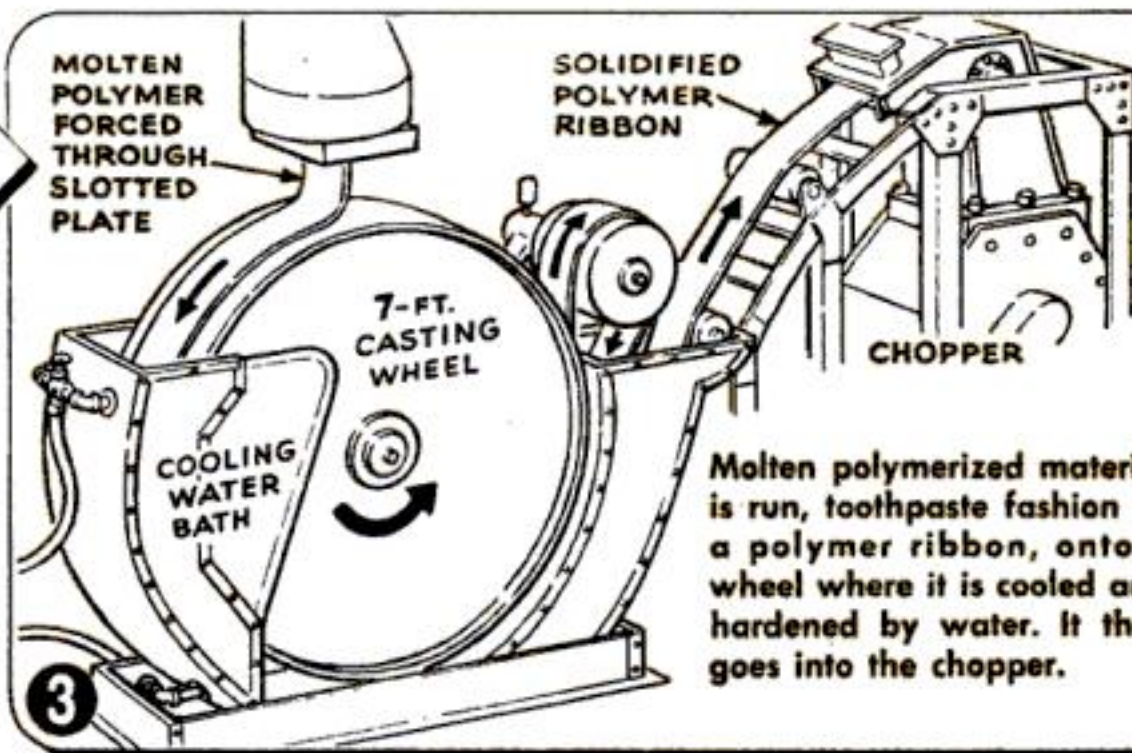
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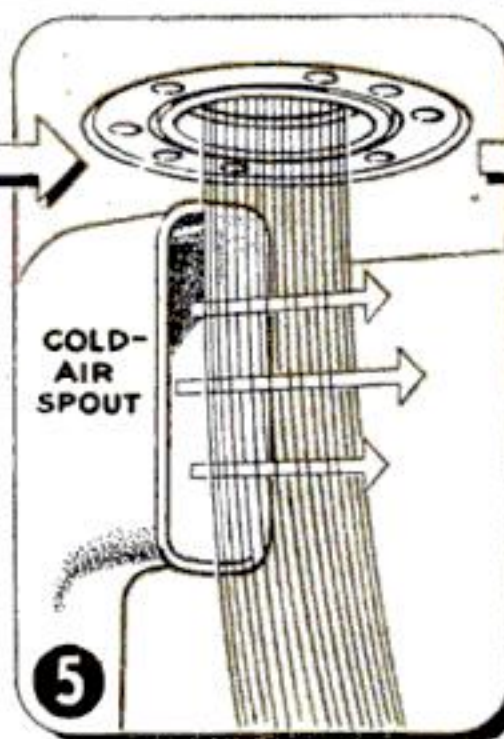
BASIC NYLON MATERIAL



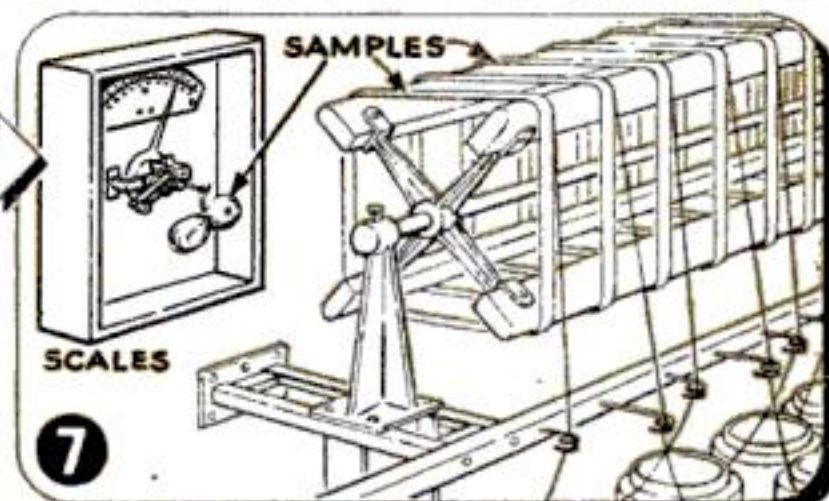
These vats polymerize the material at high temperatures, making the small molecules join to form "long-chain" molecules.



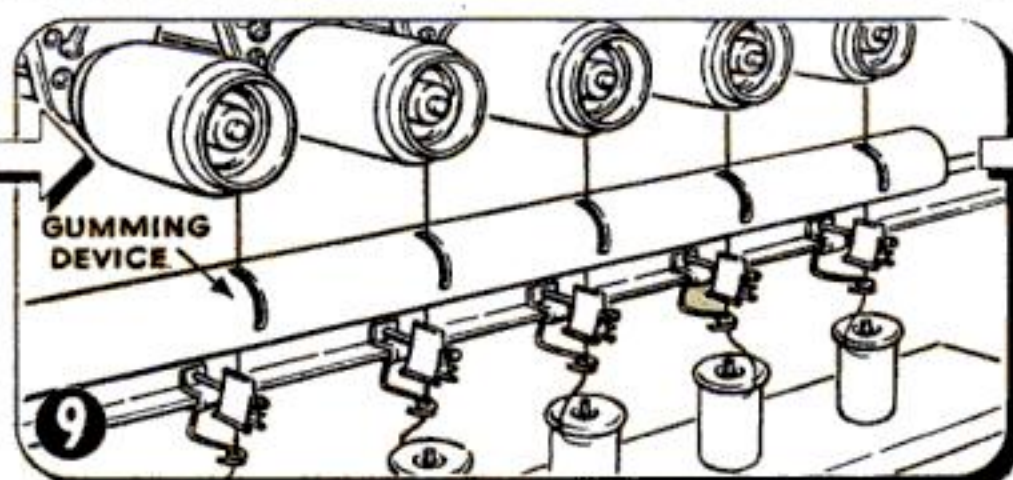
Molten polymerized material is run, toothpaste fashion as a polymer ribbon, onto a wheel where it is cooled and hardened by water. It then goes into the chopper.



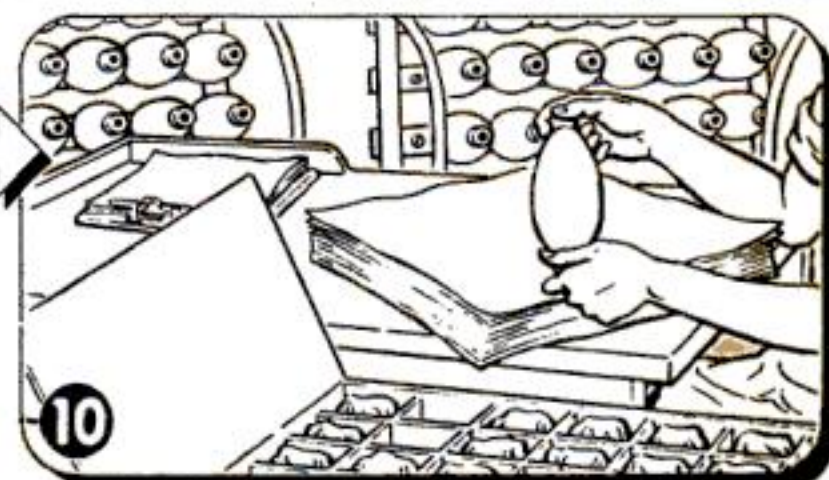
After the blended polymer is melted again, it is forced through tiny holes in a metal plate (left) to make nylon filaments (above). These harden immediately in cool air and are then spun on spinning machines to make nylon yarn.



Sample of yarn of predetermined length is taken from each bobbin and weighed to determine yarn's "denier," or size. This sample is clipped off at the reel. Thus the bobbin can be classified for nylon's thickness.

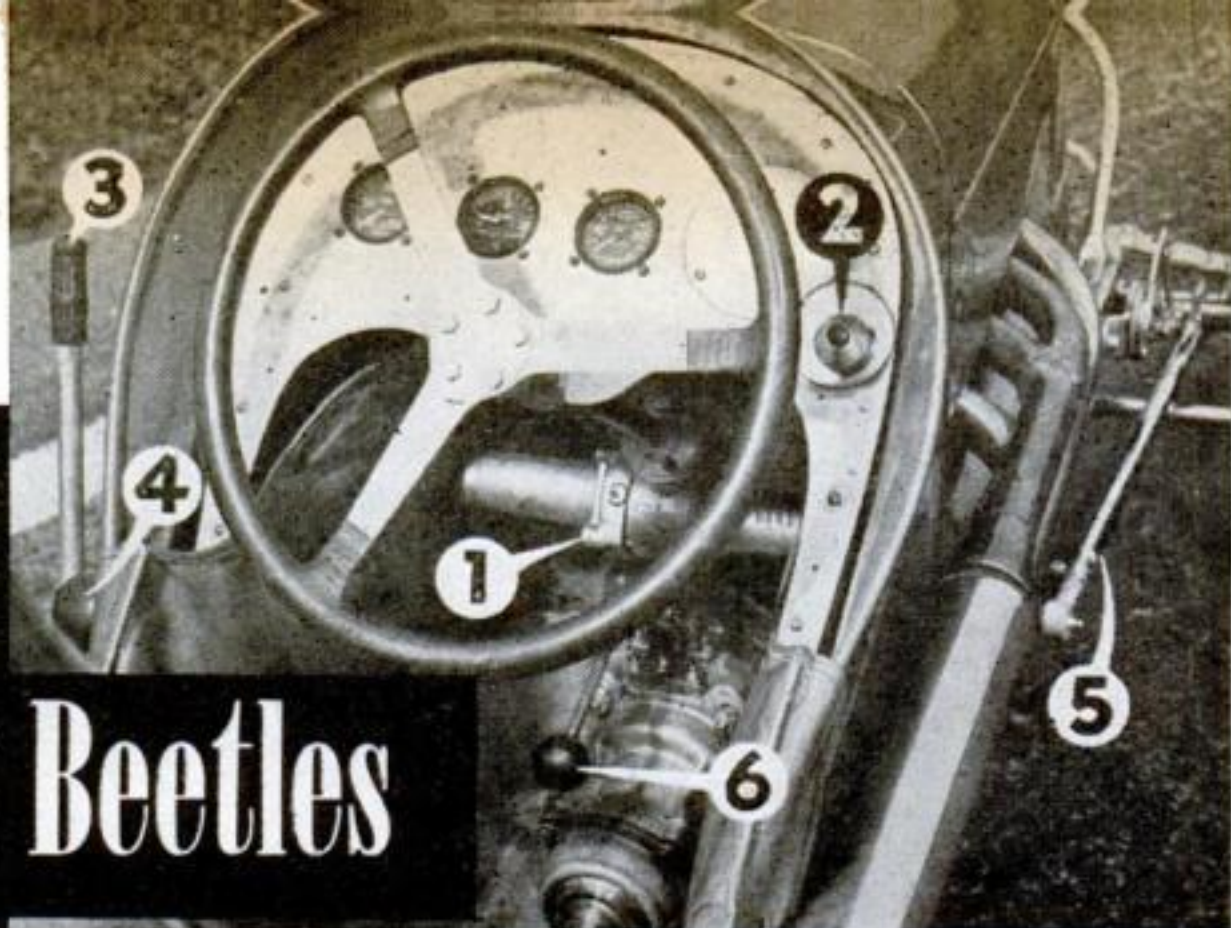


The thread is wound from one spool to another, passing through a mechanism which applies a gummy substance. This protects the yarn while it is being knit into stockings or nylon fabrics.

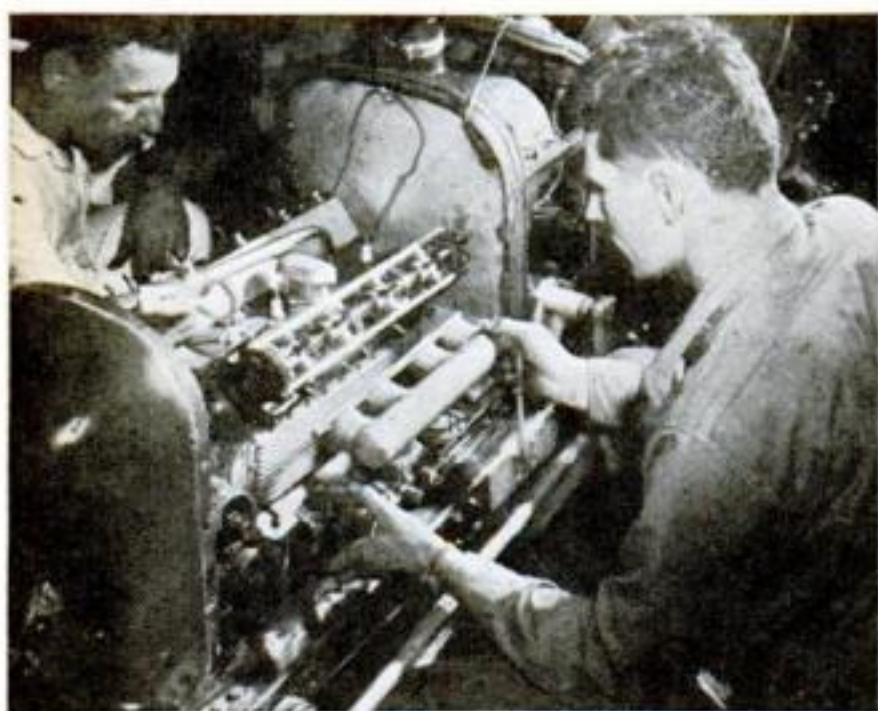


The mills require that each spool or bobbin of nylon thread be carefully inspected and found in flawless condition before it is packaged for shipping to knitters.

A midget's cockpit is a shoehorn fit. Indicated are: (1) steering mechanism gear box; (2) button to stop engine in an emergency; (3) hand brake; (4) hand oil-pressure pump; (5) radius rod aligning axle and frame; (6) gear shift.



Speeding Up The Roaring Beetles

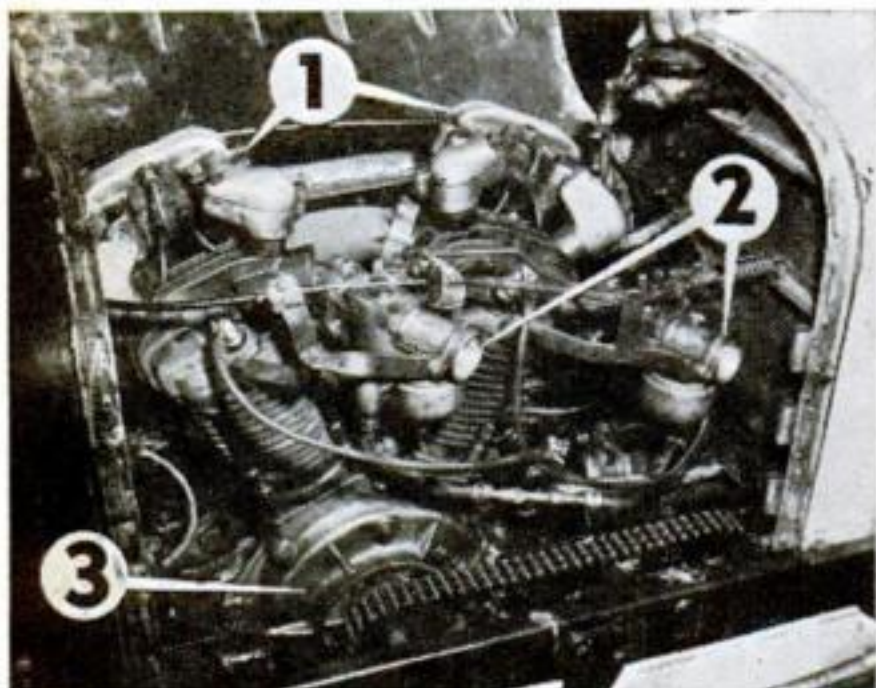


Most popular and successful engine for midget racers is the Offenhauser, which costs up to \$2,000. The photo above shows the unconventional but easily accessible twin cam towers that operate the power plant's overhead valves.

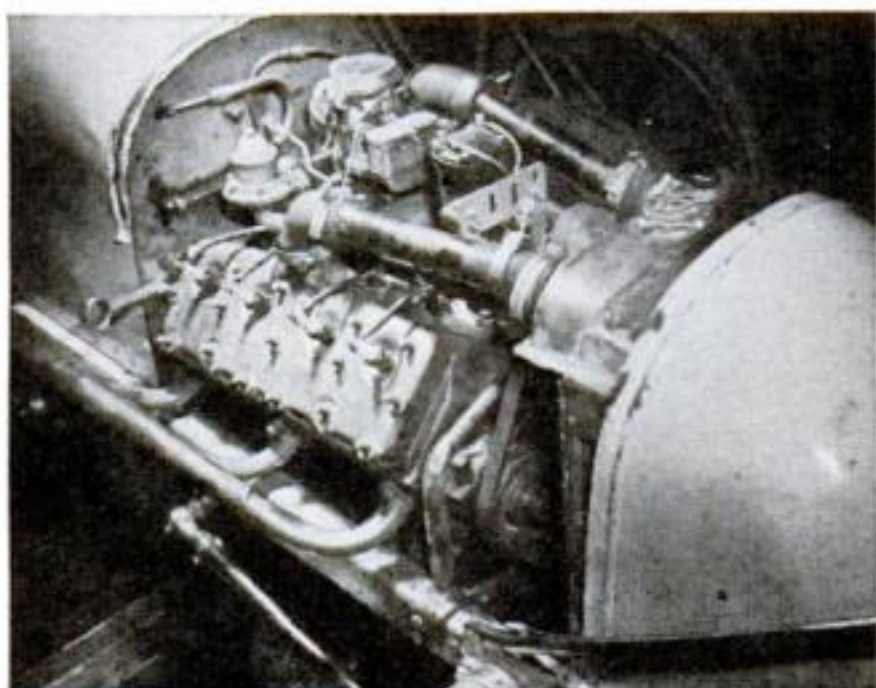
How the midget racers are tuned to win

RAZZLE-DAZZLE and rough, midget auto racing is winding up its first postwar East Coast season with important money in its pocket to testify to its success as a crowd pleaser. On 20 eastern tracks the noisy sport drew throngs approaching 200,000 a night, and some 250 drivers are now on their way to tracks in the south and west.

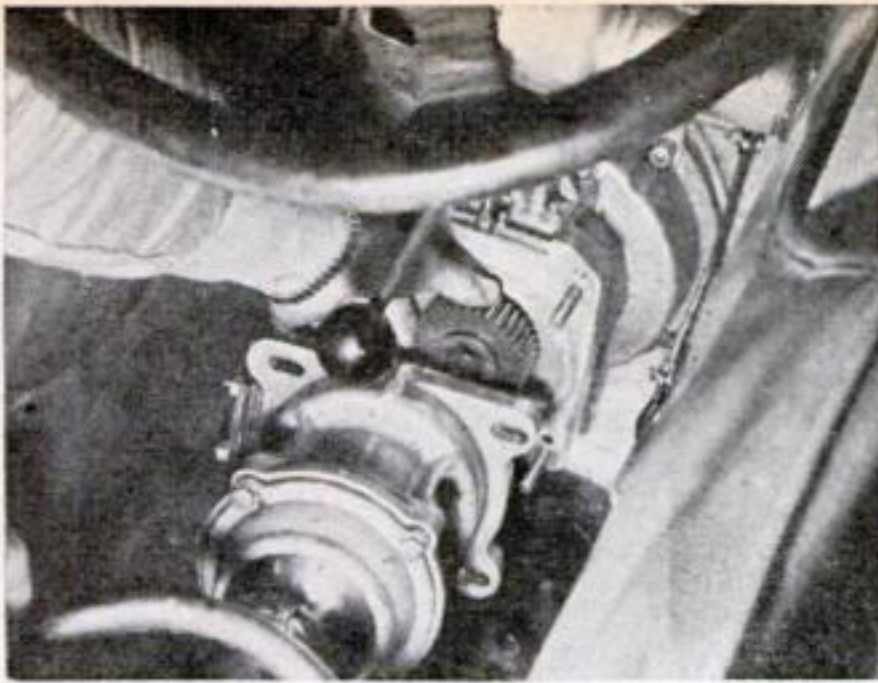
Midgets race on tracks a quarter or a fifth of a mile around. Some crack drivers earn as much as \$10,000 a season—in 1941, one cleaned up \$23,000 in 14 weeks. The average midget weighs about 850 pounds and has a 74"-78" wheelbase. Accidents are plentiful, but more spectacular than lethal—the midgets and their drivers are tough.



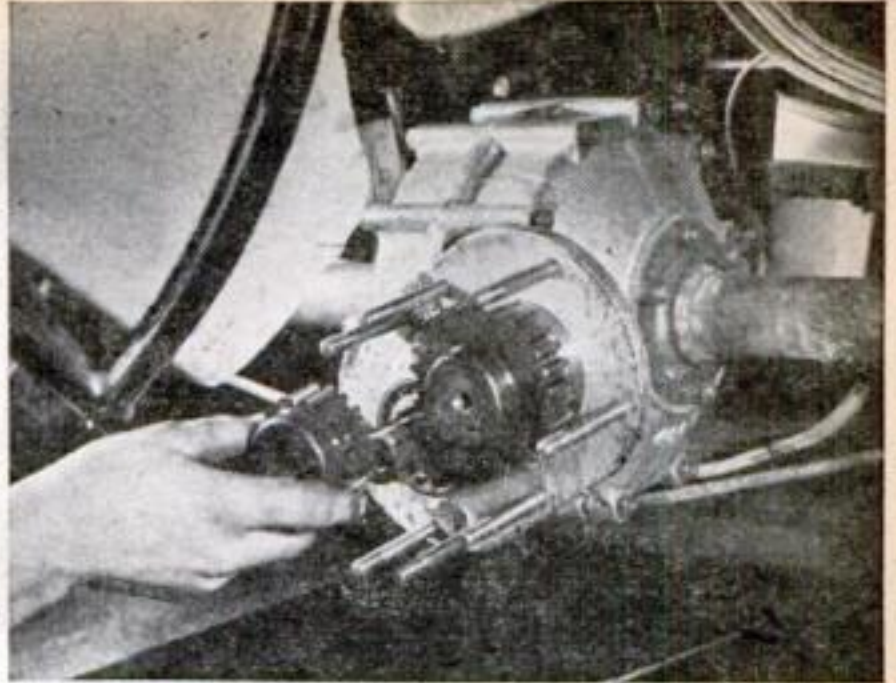
Every type of power plant—from converted outboards to souped-up motorcycle engines—is used in midgets. This made-over motorcycle engine shows: (1) housings for valve mechanisms; (2) twin carburetors; (3) crankcase with chain drive.



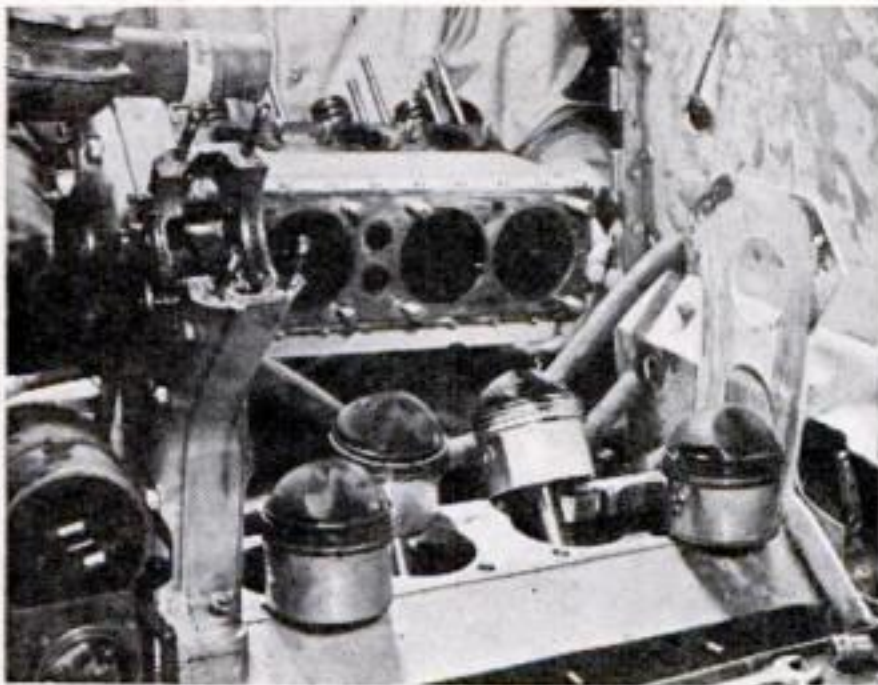
Here is how a Ford V-8 is converted into a package compact enough to fit a midget. "Cold" spark plugs are used on such engines when they are new but are replaced by "hot" ones as wear develops. Midgets have made 125 m.p.h. on a straightaway.



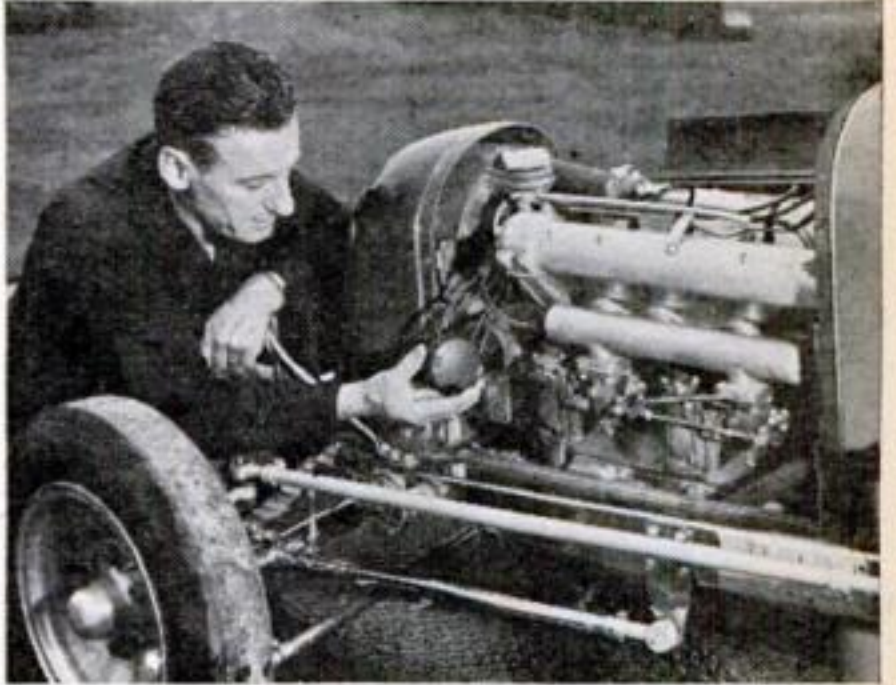
Gear ratio between crankshaft and wheels can be changed on most racers in 15 minutes. Here the assembly is exposed by removing only four bolts. Most drivers are skilled mechanics and spend considerable time keeping cars tuned up.



Here the gear ratio is changed on a Ford-powered racer. Good "beetles" cost around \$6,000, even though largely assembled from parts out of junk yards or home machine shops. Their drivers are seldom seriously hurt, though accidents are frequent.



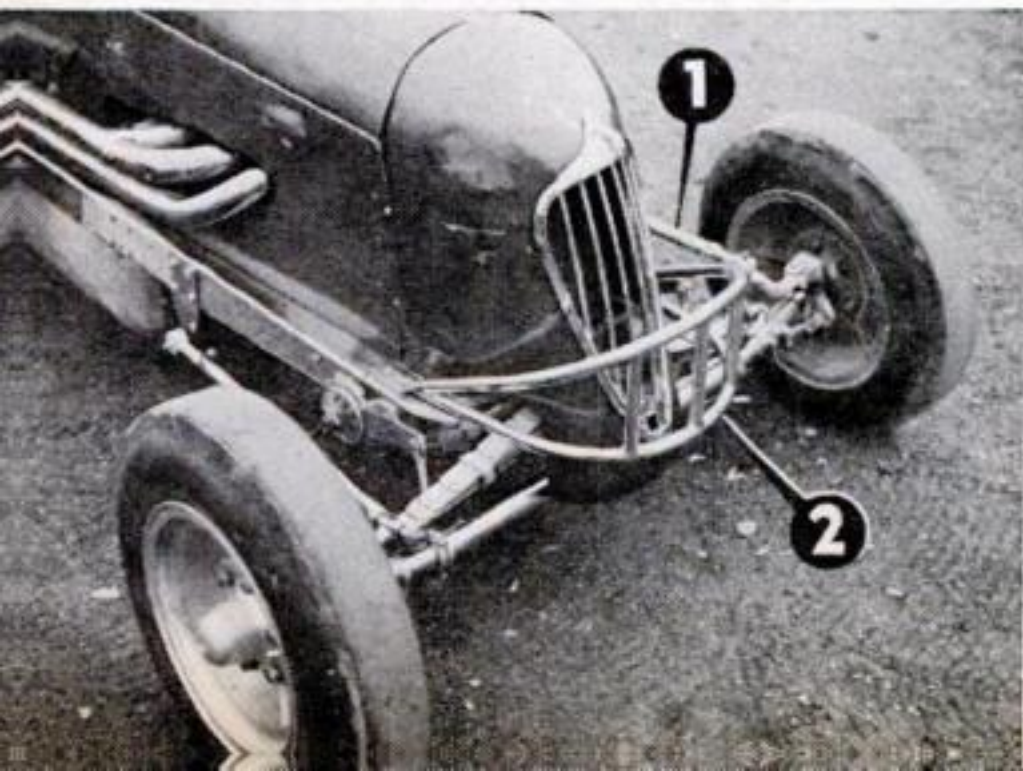
An Offenhauser, above, has rounded piston heads that boost turbulence and combustion. The compression ratio is 14 to 1. Piston displacement is limited to 140 cu. in. for flathead engines, 105 cu. in. for overheads, 65 cu. in. for outboards.



Walter Gerner, a midget owner, checks a distributor cap. Many drivers do not own machines but race for a percentage of winnings. Eastern owners and drivers pay dues to American Race Drivers' Club or American Racing Association.

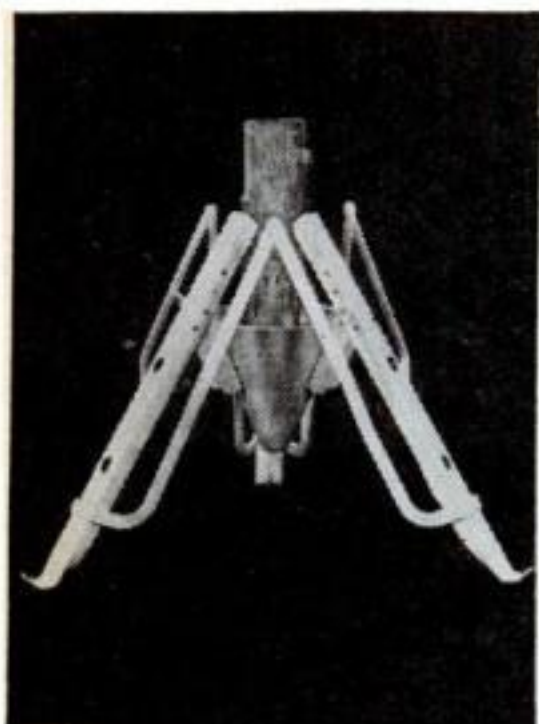
Front end of midget shows: (1) special steering rod; (2) bumper. Car's right tire is larger than left one for stability on turns. Tires are beveled on edge opposite direction of turn to hold them on rims. Track speeds seldom exceed 70 m.p.h.

With a meet over, driver and crew haul their tiny breadwinner to the next speedway on two-wheeled trailers. Some drivers race as often as five days a week. The payoff is for speed, and the midgets grow faster and faster year by year.



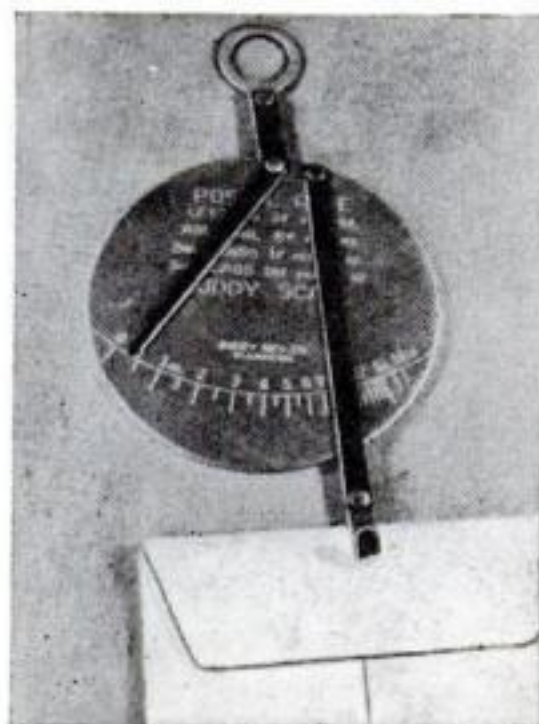


INDUCING SLEEP through mental suggestion is the aim of a special record created and recorded by Ralph Slater, a hypnotist. Entitled "Time to Sleep," the 12" unbreakable record is produced by the De Luxe Record Company, of Linden, N. J. One side is devoted chiefly to an explanation of what the record is intended to accomplish; the other, carrying the voice of the hypnotist with an accompaniment of soft music, gets down to the job of creating a state of mind that will help the listener go to sleep.



A CHRISTMAS-TREE stand distributed by Bradley, Laurens & Campbell, New York, adjusts itself automatically. When the butt is placed in the funnel-like base, the weight of the tree actuates clamps that grip the trunk.

NO SPRINGS. A postal scale made by Buddy Mfg. Co., St. Louis, gives a reading when the disk is swung upward by the weight of a letter or a package hung on the off-center lever.

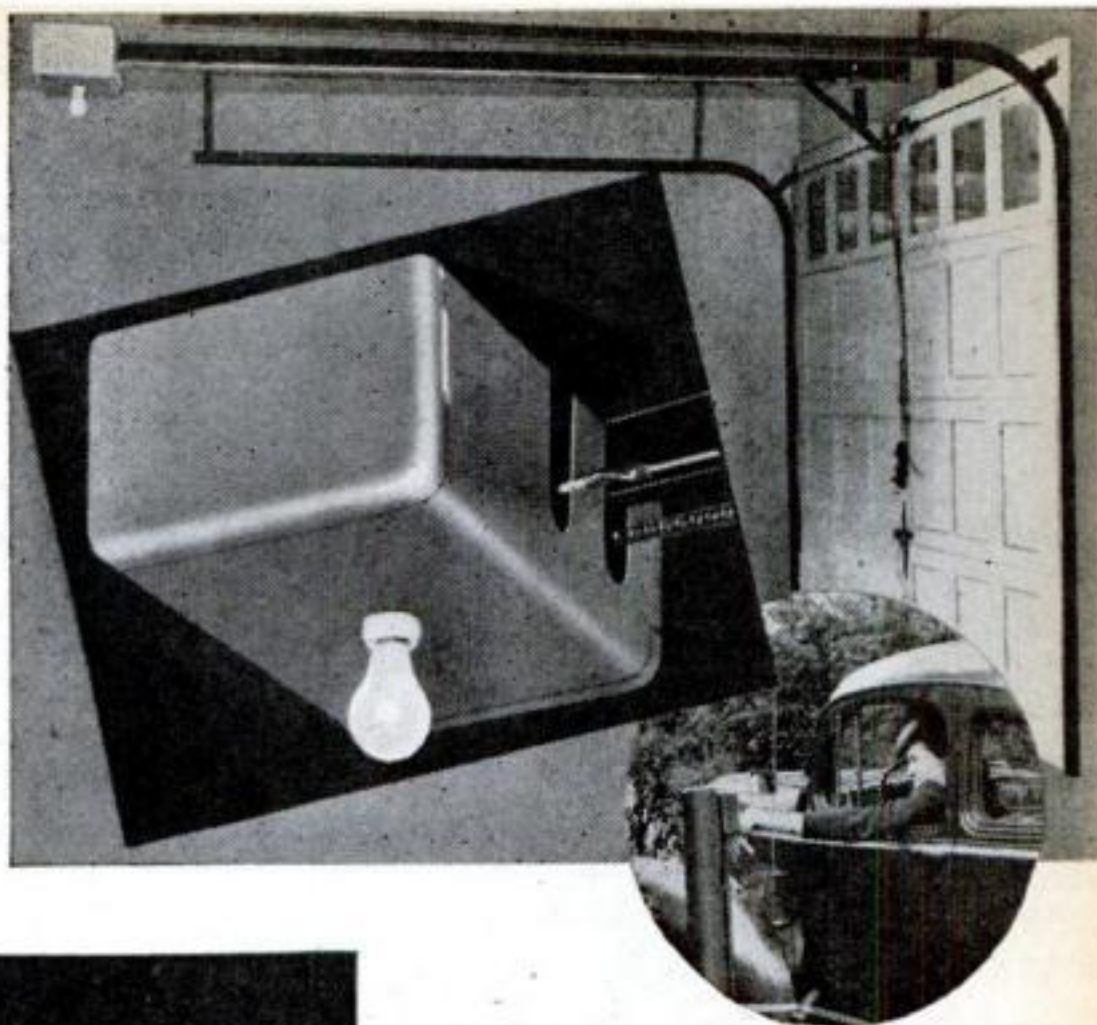


STERILIZED NIPPLES stay that way when placed on the bottle with the gadget illustrated below. Produced by I. B. Kleinert Rubber Co., New York, it consists of a cir-

cular aluminum frame with three compressible prongs that slip inside the nipple. As the frame is pushed over the bottle, the prongs spread the nipple so that it goes on easily.

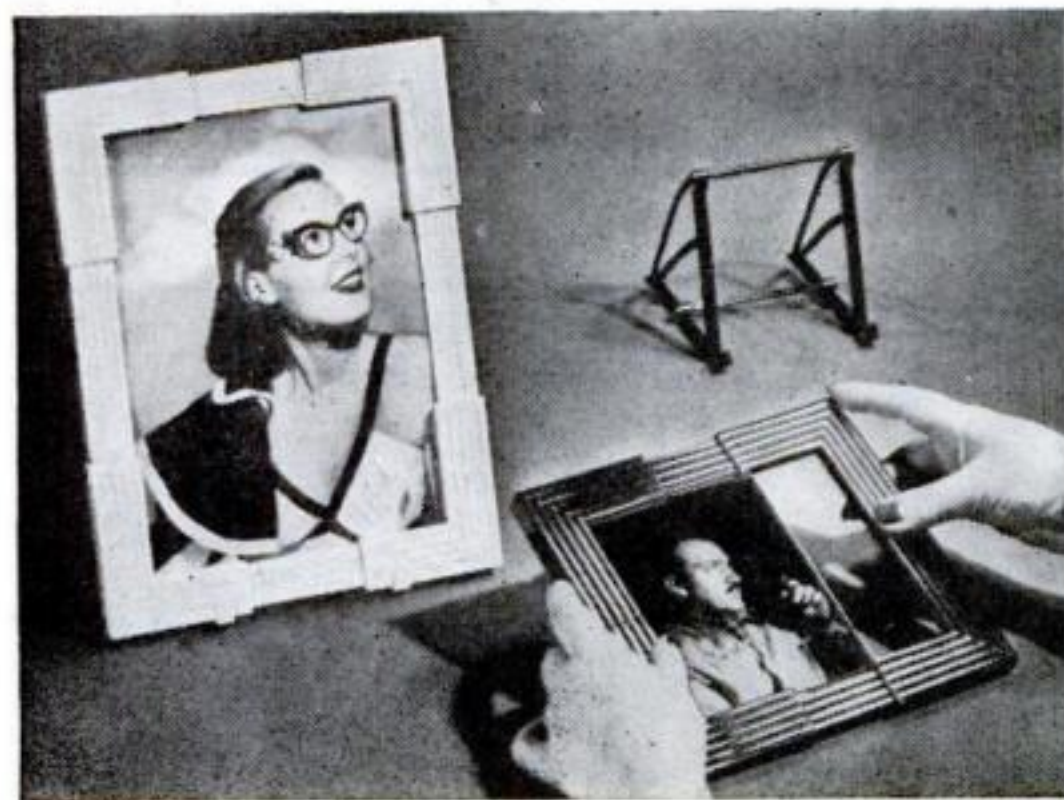


GARAGE DOORS of the over-head type can be unlocked and opened without leaving the driver's seat by installing a "Driv-Rite-In" made by the Era Meter Company, Chicago. It consists of an electrical mechanism in the garage connected to a key-operated switch on a post beside the driveway within arm's reach of the car. The system also works in reverse to close the door after you have taken out the car. As an additional convenience, a garage light turns on when the doors open and turns off when they close. A control also is located inside.



CONDENSED-MILK CANS may be sealed, as well as opened, with a device distributed by Bernard Paul & Co., Berkeley, Calif. When milk is needed, the opener-sealer may be raised as above to permit pouring. Allowed to go down, it seals the can.

ONE-HAND OPERATION makes this flour sifter a kitchen convenience. A product of the Foley Mfg. Co., Minneapolis, Minn., it has a tapering bottom to prevent flour from spilling outside the measuring cup as it is being sifted.

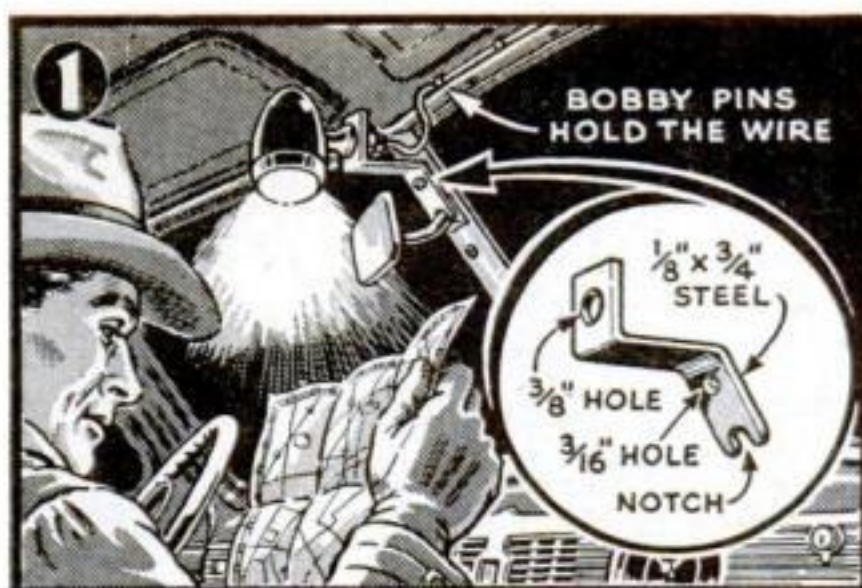


THIS PLASTIC FRAME expands or contracts to fit any picture between 4" by 5" and 8" by 10", and concealed springs hold it rigid at any size. Barrett Plastic Products, Inc., makes it in a variety of colors. It can be set on an accompanying easel or hung from a hook on a wall.

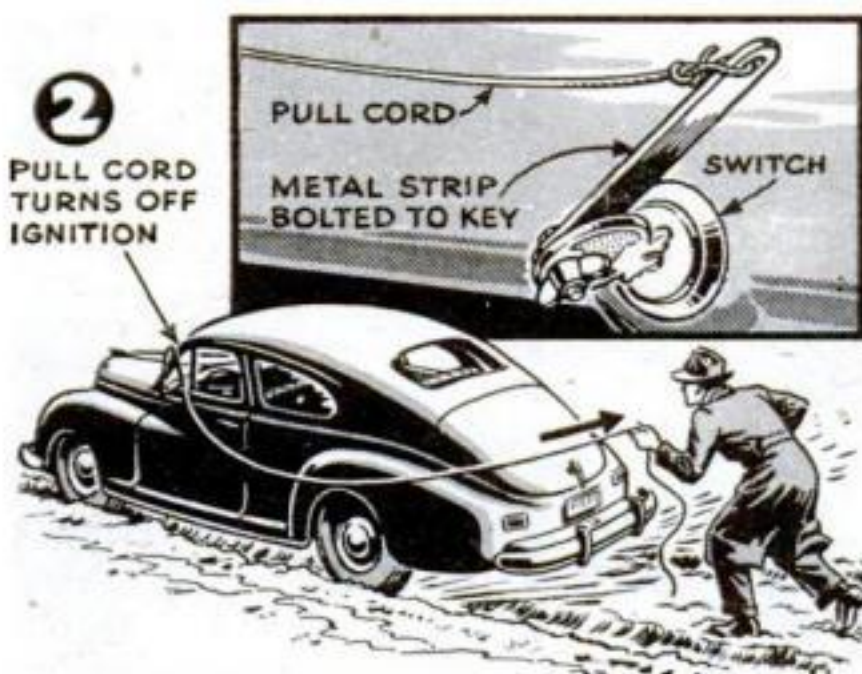
AUTO HINTS



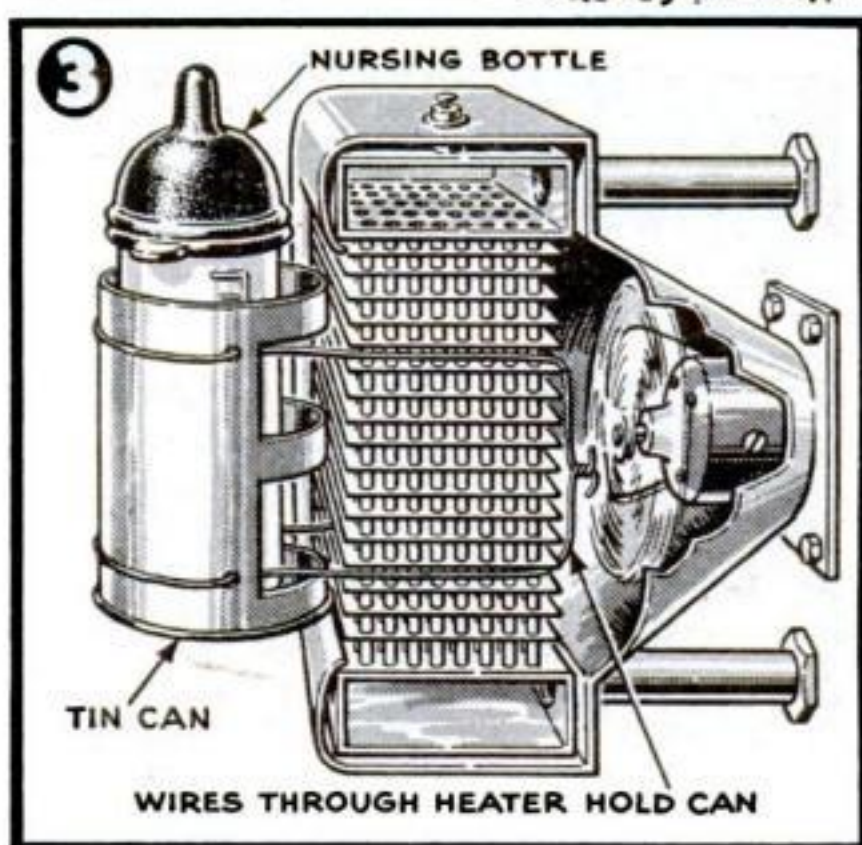
1 LIGHT UP FRONT for reading road maps and the like can be supplied by an inexpensive parking lamp mounted on a bracket above the rear-view mirror and connected to the car wiring system. A toggle switch should be wired in the circuit.—W. D. S.



2 REMOTE IGNITION CONTROL is an important safeguard if you push a stuck car. Use a metal strip bolted to the key and attached to a cord that can be pulled to turn the switch off. Then, when you're alone and stuck in slush or mud, you can push the car yourself with the motor in low gear and still turn off the ignition instantly.—H. K. F

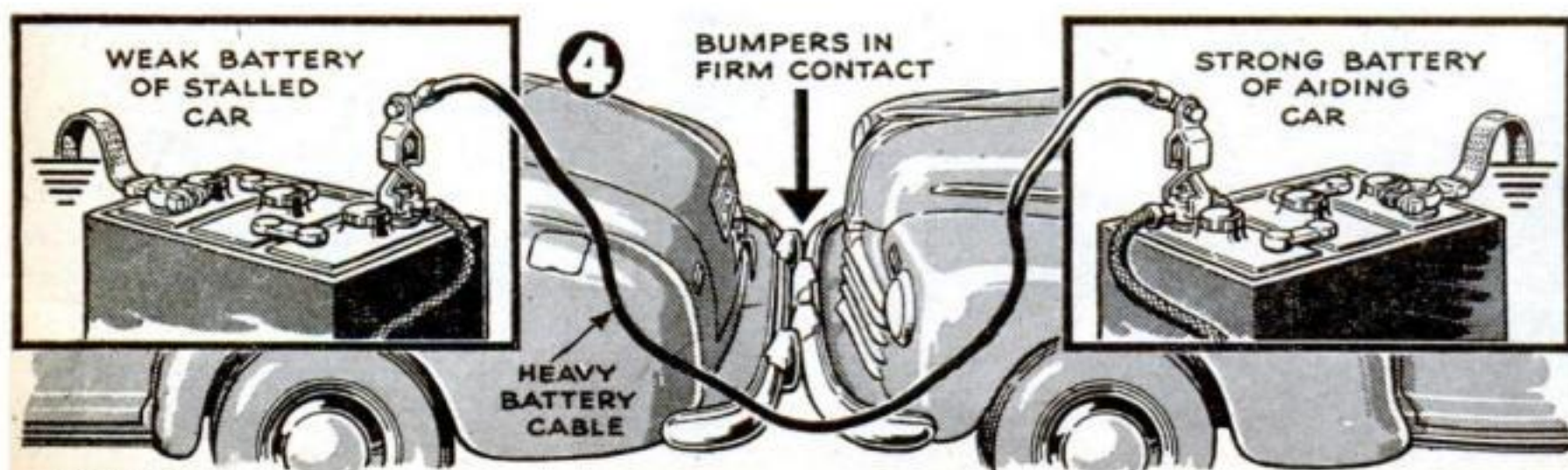


3 HEATING A BABY'S MILK while on a motor trip can be simplified by wiring a bottle holder to the car heater. Use a tin can to hold the bottle and cut out part of one side to admit heat. Run wires through holes and around the top and bottom and then through fins of the heater, twisting them together at the back.—C. W. N.



4 BOOSTING A WEAK BATTERY with current from a strong one is a trick performed with a length of heavy battery cable and two heavy-duty spring clips. Place the bumpers in firm contact for a common ground and attach the cable to the ungrounded terminals. The engine of the car with the strong battery should be kept running at a good charging speed. Make sure that the grounded sides of both batteries are of the same polarity.—J. H. D.

Drawings by STEWART ROUSE



Gus Beats the Clock by Two Cylinders



By MARTIN BUNN

WITHOUT warning the street door to the Model Garage office was thrust open and a breathless voice shouted: "Where is everybody? Can I use the phone?"

Gus Wilson looked up from the car he was working on and into the office through the open shop door.

"Sure," he told the newcomer, a young man in a brand-new conservative gray suit, and he put down his wrench and walked into the office, wiping his hands on a piece of waste.

Joe Clark had knocked off an hour early that afternoon, and Gus was keeping his eye on his partner's office while finishing up a job on the shop floor. The young man, obviously a veteran even without the discharge button in his lapel, had already given a number down in the city and was nervously watching the clock on the office wall.

"That you, Mr. Beldon?" he said anxiously into the phone. "This is Clyde—Roger Clyde . . . Yes—yes, I'm on my way, but I'm having—I mean, something came up that delayed me . . . What's that?"

His face lost all remnants of its ruddy outdoor glow, and beads of perspiration broke out on his forehead.

"But you can't do that!" he pleaded. "You promised . . . Well, I'll make it."

He hung up the phone with a look of

almost desperate determination on his face.

"Know the Riverside Apartments in the city?" he asked Gus. "I've got to be there in exactly 45 minutes, and you've got to get me there!"

"Why me?" Gus wanted to know. "You've got a car. I hear its motor running outside. You can easily drive it in a half hour."

"But you don't understand," retorted Clyde. "Two cylinders are missing . . ."

"So what?" Gus cut in. "Even with two cylinders missing, you can make it."

"Don't argue with me," Clyde shouted. "I want it hitting on all eight."

Gus began to suspect that his visitor was AWOL from some psychiatric ward. "Take it easy, son," he said soothingly. "I'll be glad to help you, but . . ."

"Quit stalling," the man said and dragged him outside. "There can't be anything serious. The car's just out of the shop."

Gus listened to the motor of the sedan. "Two cylinders are missing, all right," he agreed. "When did you lose them?"

"What difference does it make *when* I lost them?" Clyde returned. "Do something!"

Gus is usually even-tempered, but he decided the time had come for plain talk.

"Look here," he said. "If I do this job, I'll do it my way. There isn't time to check your engine, so answer my questions or take the car somewhere else."

Clyde tried to smile. "You're right," he admitted. "I've come from Hilton just after having the motor overhauled. The car ran fine for about 10 miles, and then began to miss. First it hit on seven cylinders; then on only six. I stopped at the first garage, and the mechanic put in new spark plugs. Everything was fine again—for another 10 miles. Then the motor began hitting on only six again. At the next garage, the mechanic tested all the plugs and the ignition wiring, and finally decided there was dirt in the carburetor."

Clyde paused to catch his breath.

"He charged me plenty for cleaning and

adjusting the carburetor—and what was the result? Here I am, and on six again.”

He looked at his watch. “Man, we’re wasting time!” he yelled. “Get busy!”

“O.K.,” Gus told him and lifted the hood. For thirty seconds he peered beneath it. “Stan,” he called in to the Model Garage grease monkey, “get me some tape.”

Even as he did mysterious things with the tape, the rough-running engine settled to a smooth pace. Gus straightened and dropped the hood back in place.

“All right, mister, there are your eight cylinders,” he grinned. “That’s 50 cents—and you’ve still time to get to the Riverside.”

“No, you don’t,” Clyde told him. “Those other fellows fixed it so it ran all right for a while. You’re coming with me in case it starts missing again.”

“Say, what is this?” Gus demanded.

“It’s a—a matter of life and death, almost,” Clyde pleaded. “Please come.”

Gus knew he shouldn’t, but he felt sorry for the young fellow and agreed. He told Stan to look after the shop.

“I’ll drive my own bus,” he said. “You follow. I know a short cut, and I know the cops.”

Ordinarily Gus Wilson doesn’t drive fast, but when he wants to get some place in a hurry, he can do it. When he pulled up at the Riverside with young Clyde just behind him, they had two minutes to spare.

A fat man was standing on the sidewalk with a dozen or more people grouped around him—all with that same harried, anxious look that had been Clyde’s.

The fat man looked at his watch as Clyde got out of the car.

“You cut it pretty close,” he said. “That the car?” And he got in and drove away.

Gus, looking at the disappointed faces in the crowd, couldn’t hold in any longer.

“What is this, anyway?” he asked.

“Beldon’s got an apartment he’s going to sublet to me in return for selling him my car,” Clyde told him. But the relief on his face gave way to anxiety again, and he muttered: “I hope it doesn’t start missing.”

“It won’t,” Gus assured him. “But what’s this apartment deal?”

“Beldon and I are salesmen for the same



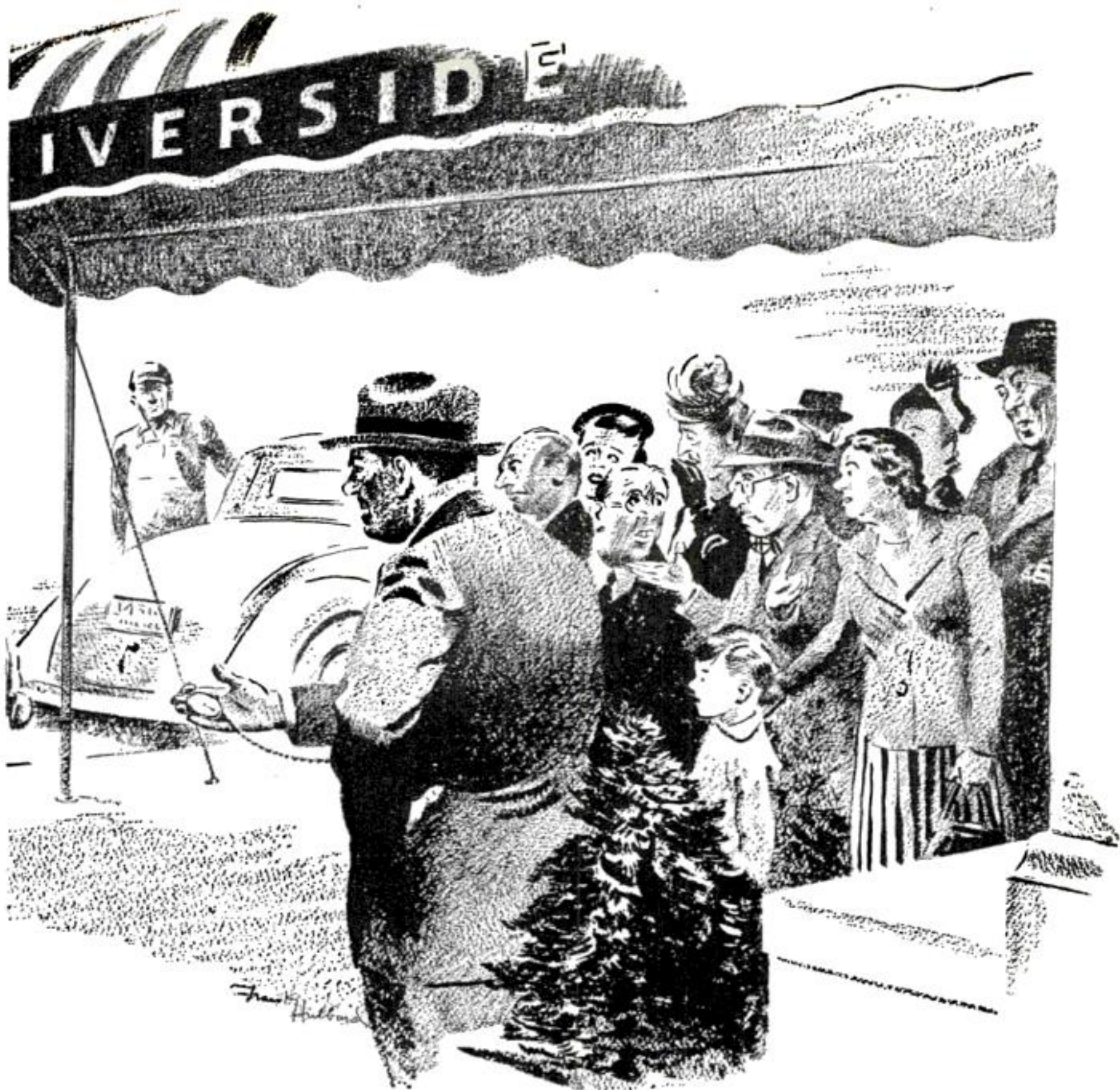
The fat man looked at his watch as Clyde got out of the car. “You cut it pretty close,” he said.

company,” Clyde explained. “I’m being transferred from Hilton to the city, where I don’t need a car, and Beldon is being transferred upstate where he does need one. I offered to sell him my car in exchange for his apartment. But he’s a tough customer, and he’d give me only until 5:30 this afternoon to deliver the car. If I hadn’t shown up, he’d have traded with one of these other people.”

“Now I see,” Gus laughed. “I knew cars were hard to get because I’m sort of in the car business, but I never dreamed the housing shortage was this bad.”

Beldon drove back in Clyde’s car and got out. “Sorry, folks,” he called to the crowd. “Clyde here has a priority on my apartment, since his car’s in good shape. I gave him my word. But if he’d been a minute late—”

“Gee, thanks, Mr. Beldon,” Clyde beamed. “You keep the car, and I’ll be down Thursday to take over the apartment and close the deal with you.” He looked at his watch. “I’ve got to catch the six o’clock train back



to Hilton. Will you drive me to the station, Mr. Wilson?"

They climbed into Gus's old but well-kept coupe, and Clyde asked what he owed. Gus added the time for the trip to the original 50 cents and pocketed the money.

"It's Beldon's worry now," Clyde said as they neared the station, "but what *was* the matter with the car?"

"Oh, nothing much," Gus laughed. "The mechanic who overhauled your engine was careless in replacing the hose that feeds hot water to the heater. In your car it passes straight over the engine and, as soon as I lifted the hood, I saw it was sagging and touching two spark plugs. Besides, you had just had your engine tuned, the spark plugs were new, and the carburetor had been cleaned, so I was looking for a short."

"But the hose is rubber," Clyde protested, "a nonconductor. It wouldn't short."

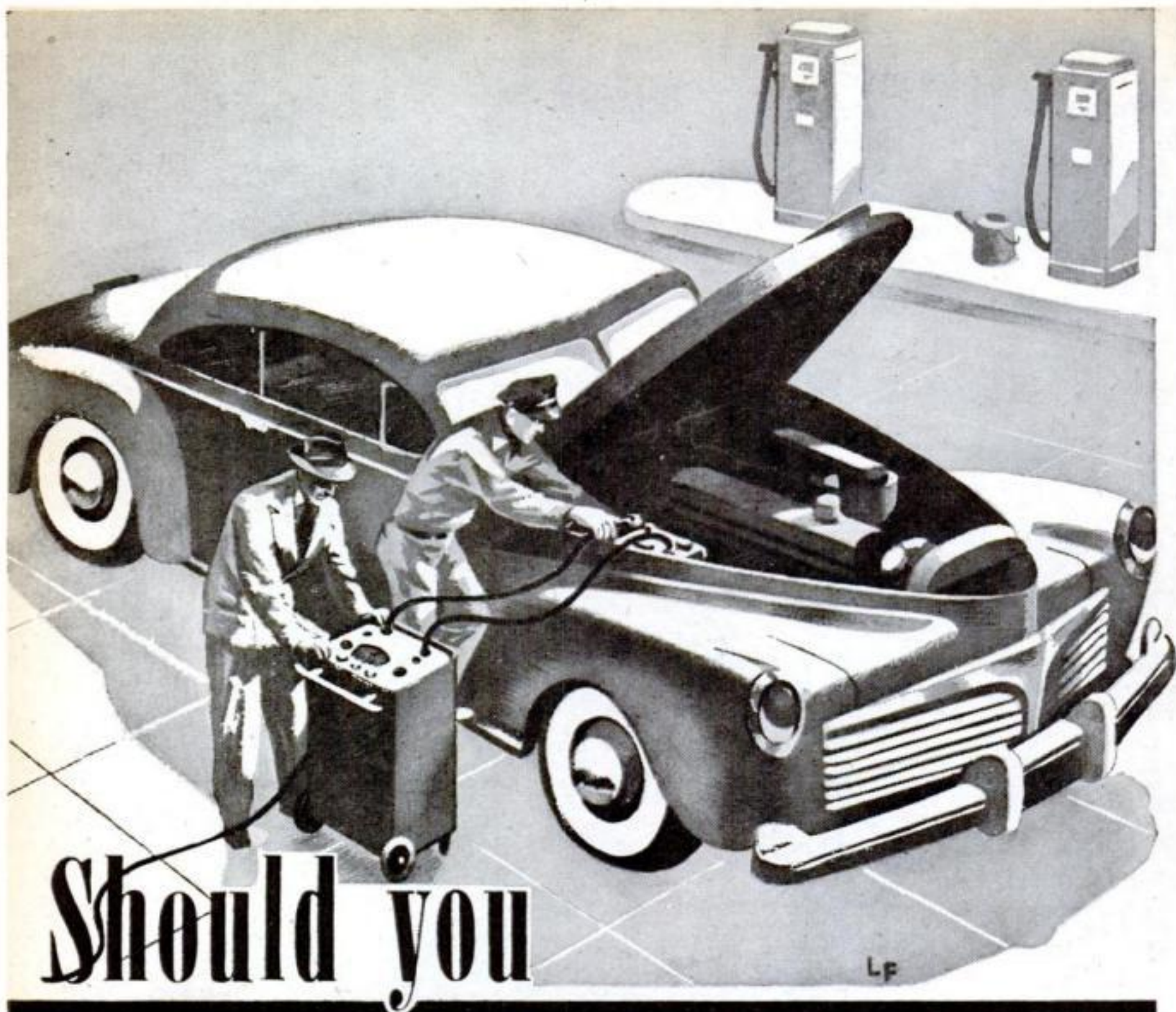
"No?" Gus grinned. "But yours must have had a little leak. I felt it, and the outside was wet—and water *is* a conductor. But taping the hose to a radiator tie rod kept it from sagging onto the spark plugs. That corrected the short."

"But why did it run fine for a few miles each time it was fixed?"

"Oh, those mechanics pushed the hose aside to check the plugs," Gus replied. "But it jogged back again on the road."

They pulled up at the station, and Clyde got out.

"Maybe I ought to tell you, Mr. Wilson," he said hesitatingly. "The real reason I needed that apartment so bad is because I'm going to be married Thursday, the day I'm to transfer to the city, and we would have had to postpone it if we couldn't have found a place to live. Wait until I see Eloise tonight! Won't she be happy!"



Should you

QUICK-CHARGE YOUR BATTERY?

By **WILLIAM H. CROUSE**

TWO basic methods are employed in charging an automobile battery. One is the procedure that has been common for years—removal of the battery from the car so that it can be charged for a day or two at a low rate. The other, which is becoming increasingly popular, is the convenient quick-charge method that many garages and service stations now provide.

A quick-charger, usually mounted on wheels so that it can be rolled right up to the car, is capable of delivering up to 100 amperes. This high charging rate brings the battery up to a reasonably charged condition in an hour or less. Because of its speed and because it usually does not involve the inconvenience of taking the battery from the car and installing a rental, quick-

charging is commanding wider and wider acceptance.

Both methods have their place, but quick-charging has certain limitations. Because of the high charging current used—the power involved may be the equivalent of 1 hp.—a great deal of damage can result from improper use of a quick-charger.

To prolong the life of your battery, it is obvious that you should check its condition periodically. This should be done with a hydrometer. But even without a hydrometer you usually can tell when a battery needs recharging, for this shows up in slow cranking and other starting difficulty.

Before a battery is quick-charged (or charged by any method, for that matter) the gravity of each cell should be checked. This will disclose three things, all of which it is well for the motorist to understand

before permitting his battery to be placed on a quick-charger.

First of all, a hydrometer check will show whether there is enough electrolyte in each cell. If there is too little for a gravity reading, the tops of the plates and separators will be exposed to air, allowing them to dry out and become damaged. In such cases, water should be added before recharging is started.

Secondly, the color of the electrolyte should be noted. If it is discolored with brownish sediment, you will know that the battery plates are shedding active material and the battery is wearing out. Such a battery should be charged by the slow method only—and for the same reason that an older person must avoid violent exercise. Quick-charging is strong medicine and would hasten the death of the battery.

The third thing that the hydrometer test tells you is the gravity of the electrolyte. A

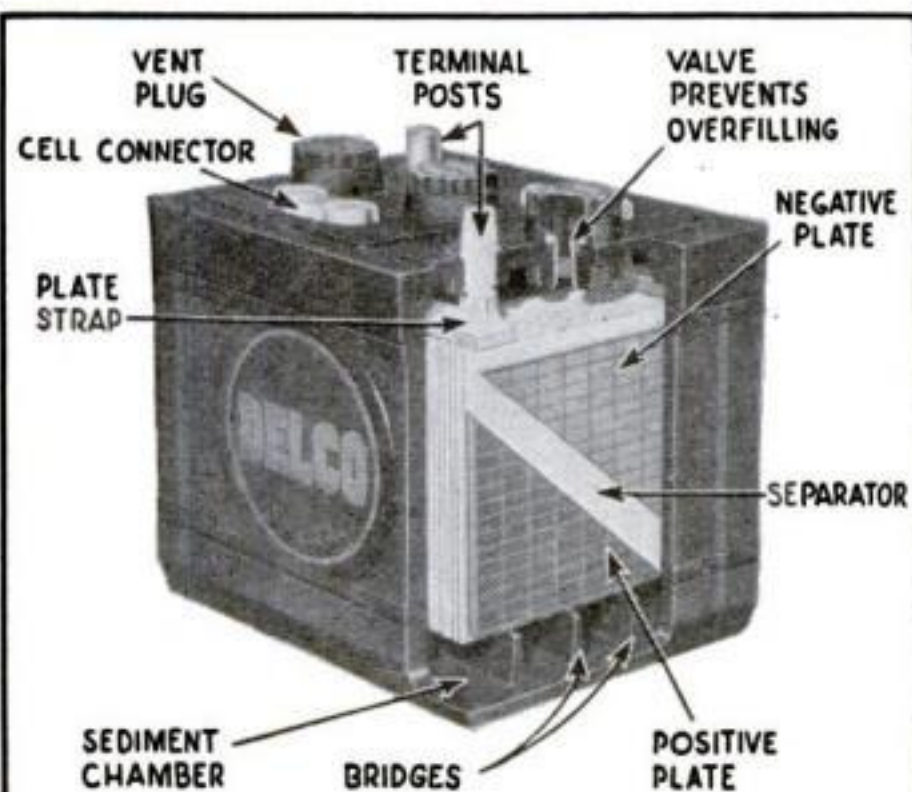
reading above 1.250 means it is fully charged; 1.215 to 1.250 that it is only half charged and that it is time for recharging; 1.170 to 1.215, about a quarter charged, and below 1.170 completely discharged. If the gravity readings of the separate cells are more than 25 points apart, you may well suspect that the low cell has an internal defect; for instance, a partial short. A battery in this condition should be slow-charged and carefully watched to see whether the low cell comes up normally. If it does not, you may find it possible to have the cell repaired or replaced.

A further check of the comparative condition of the cells can be made by testing the cell voltages after a battery has been on charge for a few minutes. If one reading proves to be more than .2 volt lower than the others, stop the charging, for the low cell probably is shorted internally. Here again, repair may enable you to get additional service from the battery if the condition is not too bad.

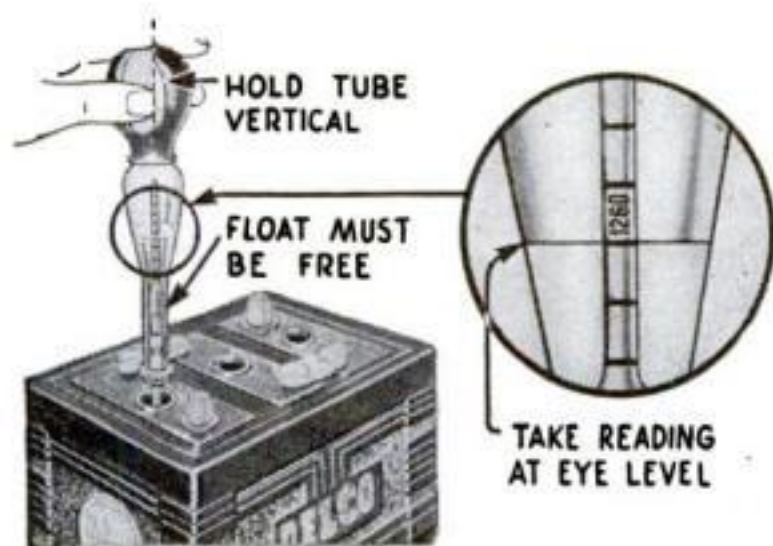
If the electrolyte looks clear and gravity readings are fairly uniform, it is safe to quick-charge the battery. But there is one final caution. Battery electrolyte temperature must never be allowed to go above 125 deg. F., for high temperature and high charging rate together add up to irreparable damage.

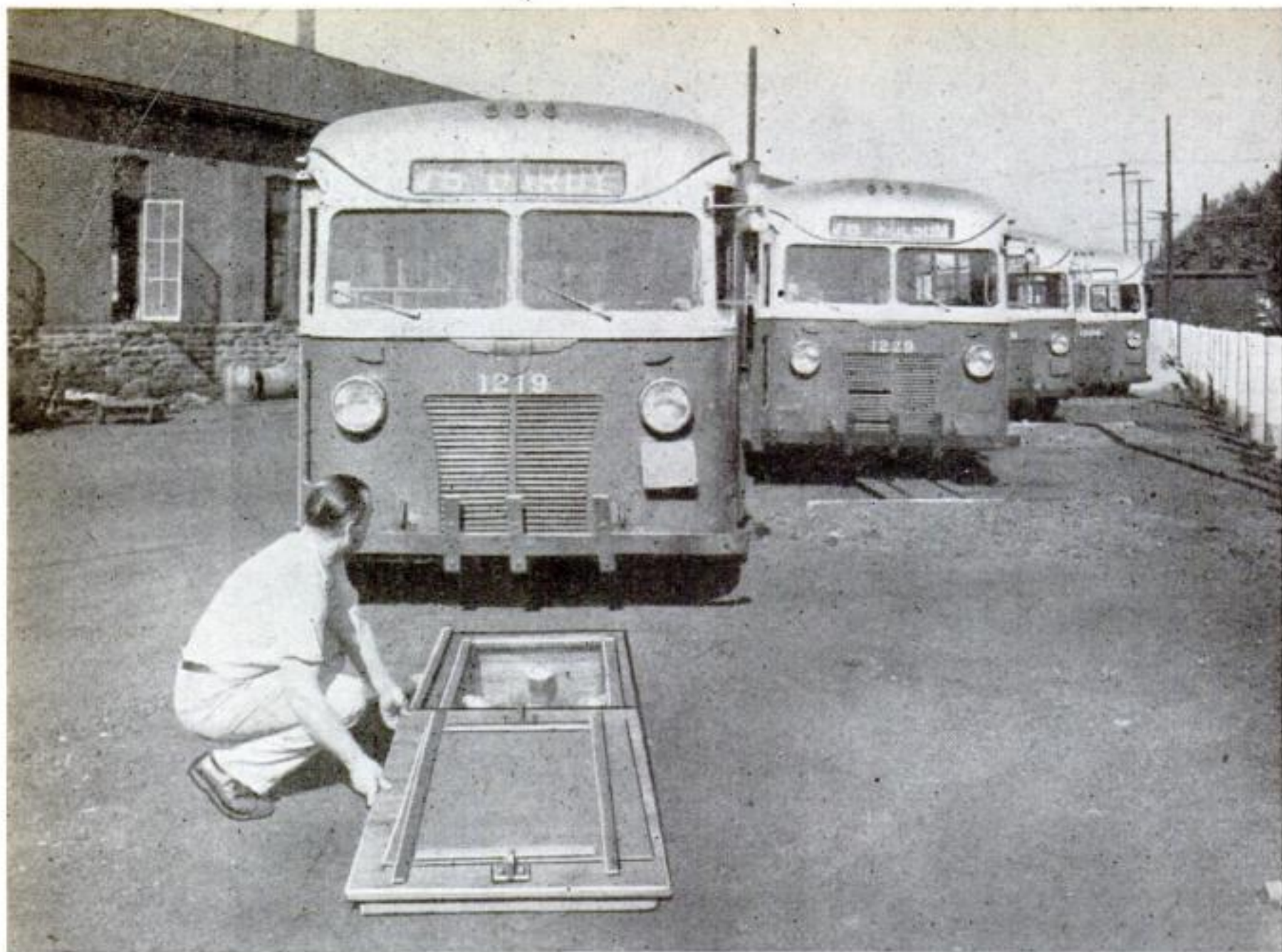
Sometimes a service-station attendant will try to gauge temperature during the charge by feeling the battery case. This is wholly unreliable since the case is an effective insulator. Heat created inside the battery by the charging process will not warm the outside immediately and it is possible, particularly during quick-charging, for the electrolyte to reach a ruinously high temperature long before the case itself begins to feel warm. The only way to check the temperature is by use of a bulb thermometer. Insert it in the center cell and make sure the bulb is covered with electrolyte when the reading is taken.

In connection with battery charging, you sometimes may see advertised or be offered chemical substances or powders that are supposed to speed up the process, or even do the entire job of recharging. The American Association of Battery Manufacturers (which includes all major battery makers) and the U. S. Bureau of Standards have found that such materials do no good and very likely will ruin the battery. Hence, it is best to avoid use of all such substances.



Here is a typical automobile storage battery, the end being cut away to show construction of one cell. How to use a hydrometer is shown below.





Four infrared lamps in a pit keep warm the underfloor engine of a bus left in the open in cold weather.

ELECTRIC HEATERS End Cold-Weather Starting Troubles

A FORTY-MILE wind is rocking the garage, and the temperature is diving toward zero. It'll be much colder by morning. You pick up an electric cord, plug one end into a socket concealed in a louver of the car hood, and flip a switch. Then you lock up the garage and go into the house for dinner, secure in the knowledge that in the morning the engine will start almost the moment you touch the starter button.

That's a preview of the application of electric immersion heaters to passenger cars stored in unheated garages. The method has already been tested and found efficient and economical with commercial vehicles. A different way of achieving the same effect—with a bank of infrared bulbs placed beneath the vehicle to throw heat up against the oil pan—has also given promising results.

Immersion heaters were tested several years ago by the Atlantic Refining Company, which maintains a considerable fleet of trucks not stored in heated garages. According to Emil P. Gohn, engineer for the company, the heaters have thoroughly proved their worth. Kept outside overnight in near-zero weather, the unheated engine of a heavy truck might not even turn over in the morning, despite a fully charged battery. With a 500- or 750-watt heater installed in the water jacket, the engine would under the same conditions respond with a quick and reliable start. Best results were achieved when the cylinder-wall temperature was brought to approximately 45 deg. F. If the temperature was raised somewhat less, say to 35 deg., starting time was almost tripled.

What's the cause of hard cold-weather

starting? Improper handling of the controls, an inefficient ignition system, or an incorrectly adjusted carburetor are all possible troublemakers. But the basic difficulty springs from the cold itself. Thick, sluggish oil on the cylinder walls and in the bearings imposes an enormous current drain on the battery (itself less efficient in cold weather); the engine is thus cranked over very slowly and the ignition system is starved of the voltage it needs to deliver a hot spark. At the same time the ice-cold carburetor and intake manifold impair fuel vaporization.

With an immersion heater at work to keep the engine's blood warm, chances of starting failure are greatly lessened. Cylinder walls, bearings, and lubricant are ready for use. The starting motor can spin the crankshaft at almost normal speed, and the spark coil isn't deprived of its share of current. Enough warmth has been conducted to the intake manifold and carburetor to take the chill off the surfaces the vaporized fuel-air charge will touch. Hence the probability of a fast start is greatly increased. But water-jacket heaters aren't a sure-cure panacea—faulty starting technique, or poor condition of the ignition or fuel systems, can still mean a dead battery and a silent engine.

An immersion heater, usually a copper-sheathed, watertight cylinder containing a length of resistance wire, should be mounted as low as possible in the cooling system, and should be located so that the heat is concentrated in the engine block rather than the radiator. One or more line thermostats in the hose or hoses leading to the lower radiator tank keep the warmed antifreeze solution from circulating through the radiator, with resultant heat loss. While installations can be made in the lower hose connection, or (preferably) in the lower inlet elbow of the

block, the ideal place for the unit is within the block itself. This would of course generally require that blocks be designed for the purpose.

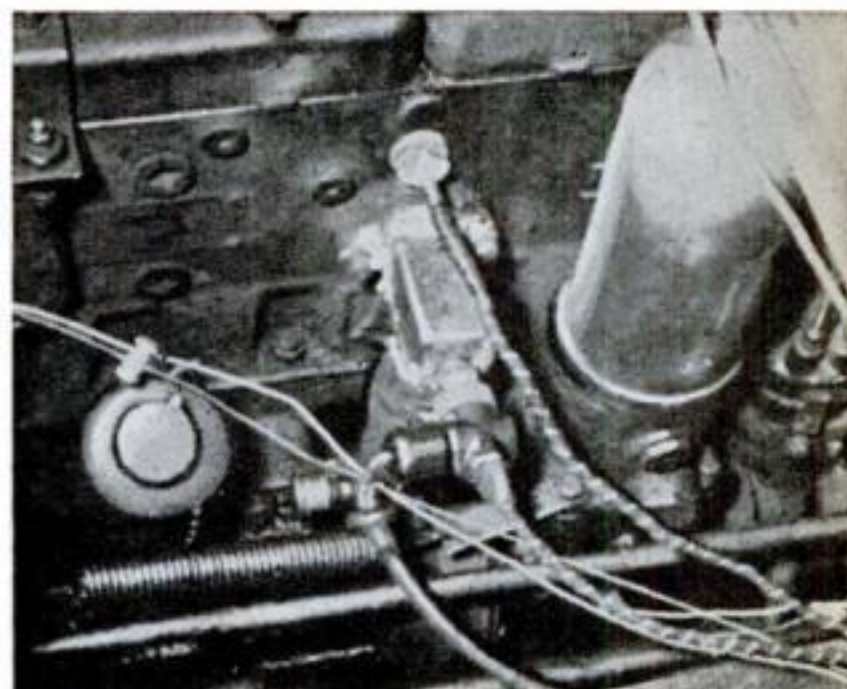
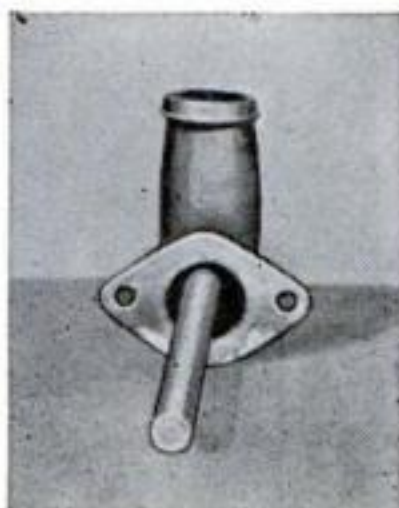
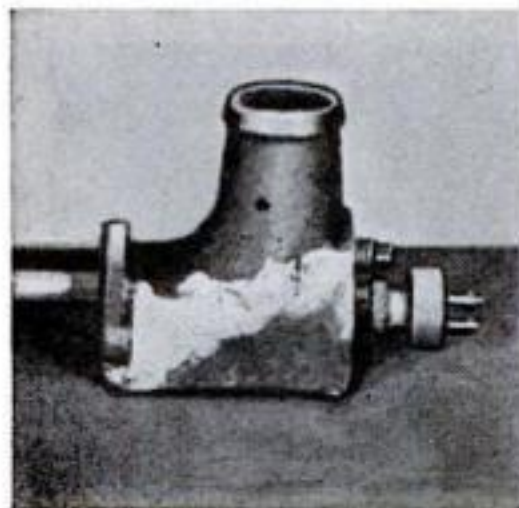
Engineers estimate that for the average light car a 200- or 250-watt heater would be ample. Though a night-long current drain of this size may not seem economical, proponents of immersion heaters point out that heating an entire garage by conventional means is hardly cheap, and that the savings on battery-charging and tow-starting fees can be considerable. Because the already warm engine doesn't have to pass through the dangerous, high-wear time when the engine has started but the lubricant isn't flowing right, the heaters probably also save money on major repair bills.

Compelled by a shortage of garage space to keep many of its buses in the open, the Philadelphia Transportation Company turned to the use of familiar infrared heat lamps. Shallow pits were dug under 27 outdoor parking berths, lined with creosoted wood, and fitted out with four 250-watt bulbs apiece. The lamps were placed so that their heat was concentrated on the underfloor engines of the buses.

According to R. H. Dalgleish, Jr., an operating executive of the company, the method has shown itself to be both practical and economical at temperatures down to 2 deg. F. He reports that less starting difficulty has been encountered with buses kept warm in this way than with those in garages where the temperatures were 35 or 40 deg.

For the car owner having either an unheated garage or none, electric engine heating has much in its favor. But pending the day when such heaters are built in at the factory, ingenious motorists will have to devise their own equipment.

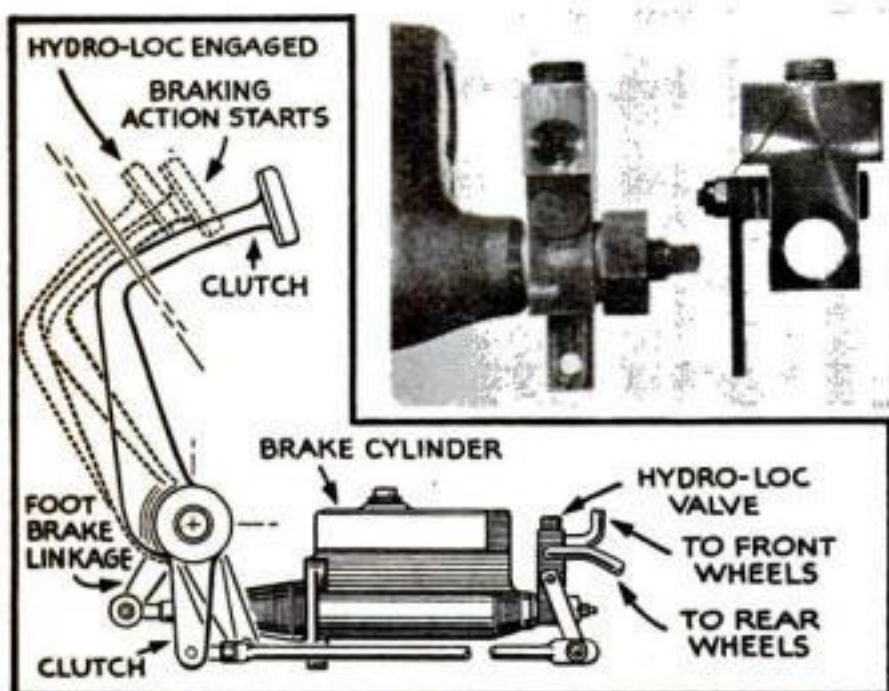
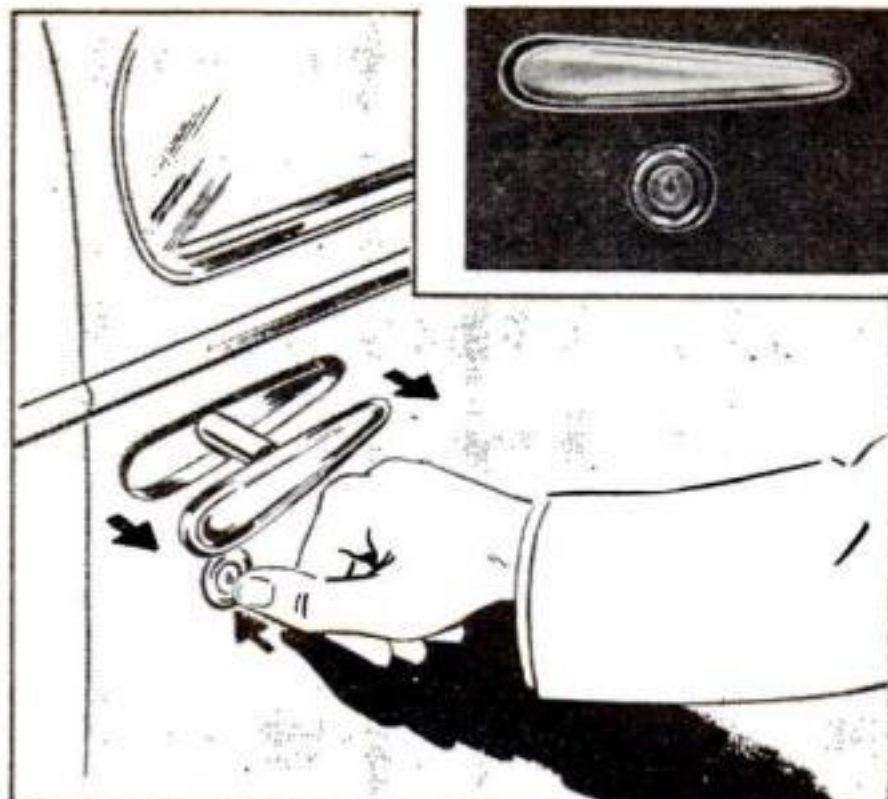
Here is the immersion heater used in experimental Atlantic Refining installations. Below, two views of the heater itself in the inlet fitting of the cylinder block. The photo at right shows two heater units in place on the engine of a big truck.



AUTO IDEAS



RECESSED DOOR HANDLES that can't catch on clothing are released for turning by pressure on a ring around the lock. Once extended, a handle remains so as long as the door is open. Shutting the door automatically returns it to its recess, flush with the door contour. Opening from inside leaves the door handle recessed. Leonard Manufacturing Co., of Los Angeles, is the maker.



ROLL-BACK ON HILLS as the right foot is shifted from brake to accelerator at starting is prevented by a new hydraulic-brake control made by Hydro-Aire, Incorporated, of Los Angeles. Foot brakes are applied as usual, but the control holds them on until the clutch begins to engage. Ordinary clutch operation is not affected.

PLASTIC REFLECTORS can now be tailored to fit and mounted over nonreflecting road signs, markers, and guard rails, saving the expense of complete replacement. The reflector material consists of tiny glass lenses

FILTER EFFICIENCY is indicated visually by the height of the aluminum spool in the glass tube shown below. The attachment, called a Filter-Meter and made by Hunter and Company, of Cleveland, is connected in the oil line to warn when a change of the filter cartridge is necessary.



embedded in flexible plastic and is available both in roll form and in ready-made signs. It is a product of the Minnesota Mining & Manufacturing Co., of St. Paul, and is known as Scotchlite.





- **Installing Record Changers**
- **Working Stainless Steel**
- **News in Home Heating**
- **Circular-Saw Stand**
- **Simple A.C. Rectifier**

CUSHION STOOLS

for EXTRA COMFORT Anywhere



Used singly, cushion stools will seat one or even two persons.

By **EDWARD E. THORP**

LARGE, square cushion stools that you can make yourself can be a big money saver in your budget for furnishing a small home or apartment. Their advantage over one-purpose pieces is easily apparent.

Placed together in a group of six, they make a comfortable bed; in threes, they form twin beds; against the wall in a corner, they turn into a corner divan; while for a large gathering each stool becomes a roomy seat for two people, answering the chair problem without the need of in-between storage.

The basic unit is a low stool fitted with a deep, comfortable cushion and nonskid feet. Since each piece is square and the sides are flush with the legs, almost any number of combinations is possible. The 24" width will provide maximum seating space with the least area of

floor space lost to other uses.

Only three sizes of lumber are needed—stock that will finish to 2½" by 2½" for the legs, ¾" by 7¼" for the sides, and almost any width ¾" boards for the top. If machine tools are not available for recessing the legs, you can use 1¾" by 1¾" stock and build up the bottom section on two sides. Neat joints for such built-up sections call for a miter box, though butt joints will serve if the exposed end grain and joint are filled with a wood filler. For six stools you will need enough stock for 24 legs, 24 sides, and six tops.

Time can be saved if all sides are cut 23¼" long and all corners assembled alike with the flush board always on the same side. Assemble one board to each leg with glue and nails; then, when the glue has set, assemble the four sides and legs in standing position on the bench to avoid wobble. The top strips may be put on solid or spaced not more than 1". A 1½" by 2½" cleat put in edgewise across the center will prevent any possible sag. Finish the exposed legs with stain and a good varnish to match the other furniture.

Grouped in double rows of three, six stools become a comfortable double bed, or in single rows of three, the six make twin beds.

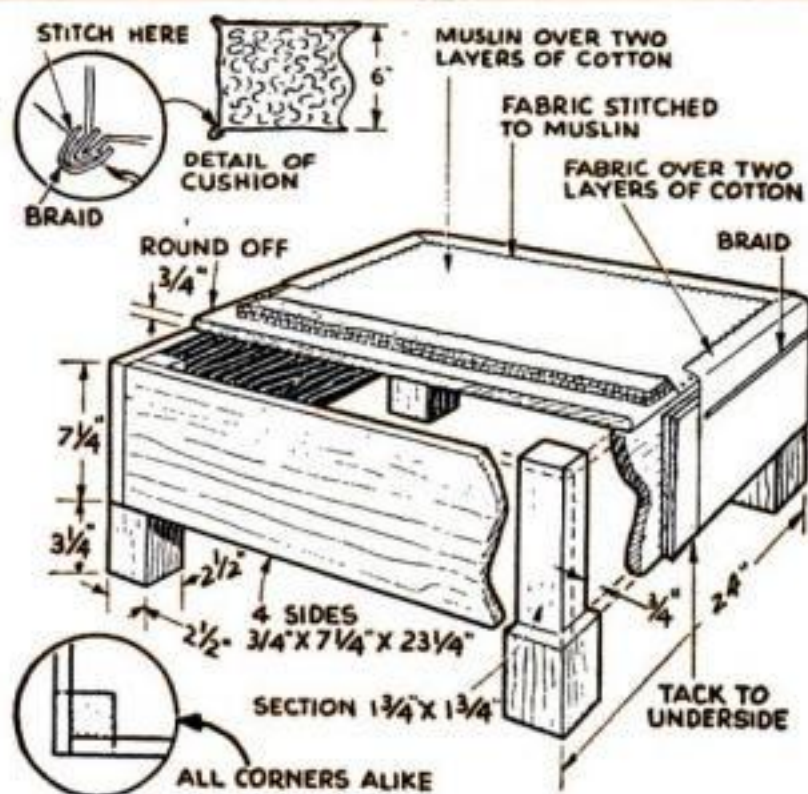


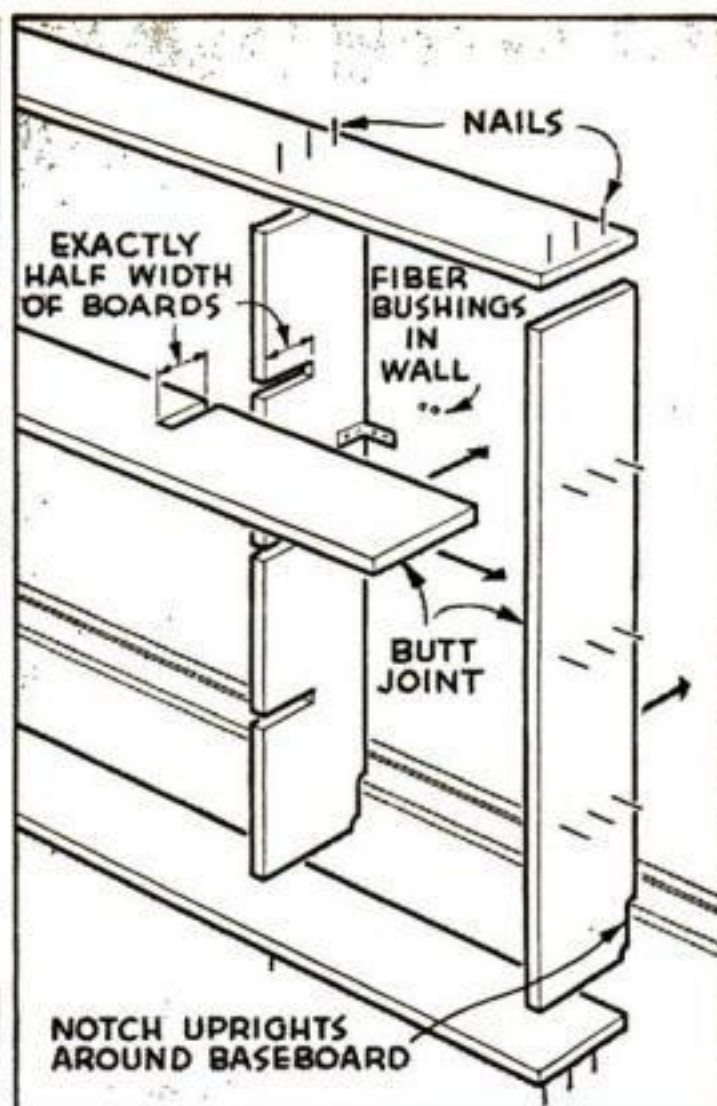


Many furnishing schemes are possible with a set of stools. Here six are used against two walls to form a modern corner divan.

Pad the top with two thicknesses of cotton batting and tack muslin over it. Then tack a 12" strip of upholstering material around the stool by its bottom edge, place two thicknesses of padding all around the sides, and bring up and stitch the upholstery lightly to the muslin. Pull out any wrinkles toward the corners and turn them in, and then stitch the upholstery material permanently to the muslin. It can be tacked also if the stools are likely to get rough usage. Muslin may also be stretched across the bottom and tacked under the sides. Inverted rubber caster cups tacked to the feet will keep the pieces from sliding.

Comfortable cushions can be made much more cheaply than they can be bought. Layer filling stands up well under use, but other types will serve if put in an inside bag and quilted or tufted to prevent lumping. Reinforcing the top and bottom edges with stitched braid will not only prevent stretching out of shape but will add to the life of the cushions by taking much of the wear from the upholstery material.





Wall-Size Knickknack Shelf Fills Blank Space at End of Room

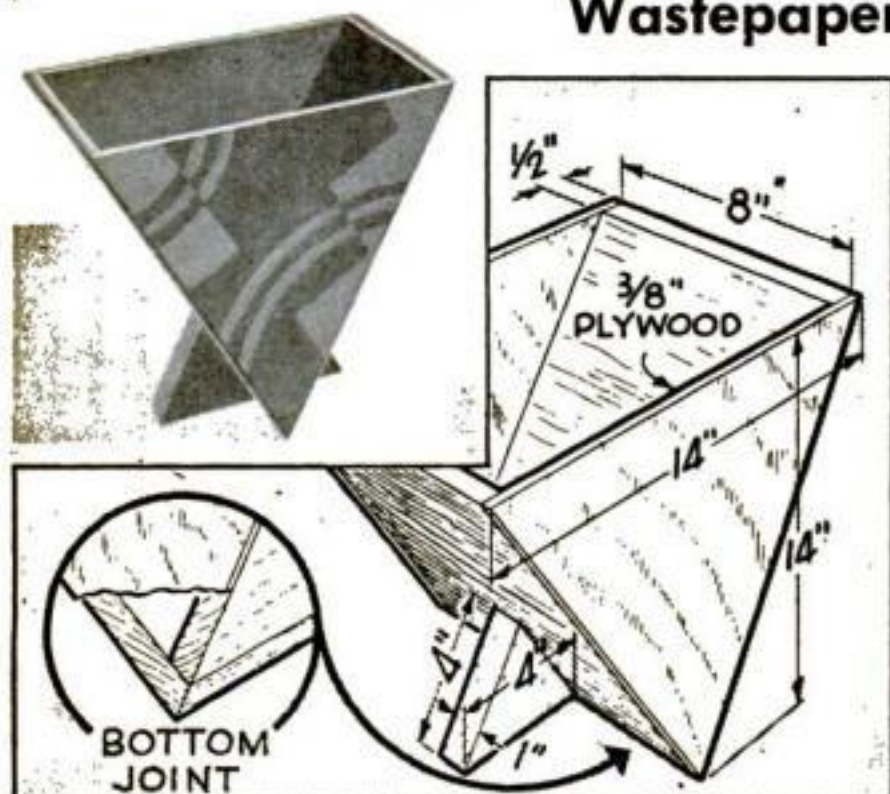
FACED with a big expanse of bare wall at one end of a sun room, we decided on a knickknack shelf. It had to be wall-size, and it holds those odd pieces that just don't belong anywhere in particular but provide an eye-filling bit of variety.

We built our shelf the hard way, by first nailing in uprights and then toe-nailing in short shelf sections to fit between. It might have been better to notch the uprights and shelves egg-carton style, as in the drawing, or to set the shelves in conventional book-case dadoes.

To get the piece flush against the wall, notch the uprights at the bottom to fit over the baseboard. And to keep the whole works from coming down with a crash, screw three or four small angle brackets under the middle shelf where they won't show. Anchor them to the wall with screws set in a stud or in fiber plugs driven into holes in the plaster.

Dimensions are up to you, since it's your wall, but make the shelves wide enough to hold your biggest knickknacks. Boards $\frac{3}{4}$ " by $5\frac{1}{2}$ " should do.—JEAN BLACKBURNE.

Wastepaper Basket Built on Modern Lines



THOUGH modern in looks, this wastepaper basket is not so extreme that it won't fit in most decorating schemes. Make the sides of thin stock or plywood. Two are square, and the other two are equilateral triangles. They are butt-joined with nails and screws, but the bottom edges of the two square pieces should be mitered for a neat fit. Two feet, also equilateral triangles, are cut from 1" stock. Despite the seemingly narrow base, the basket is quite stable.

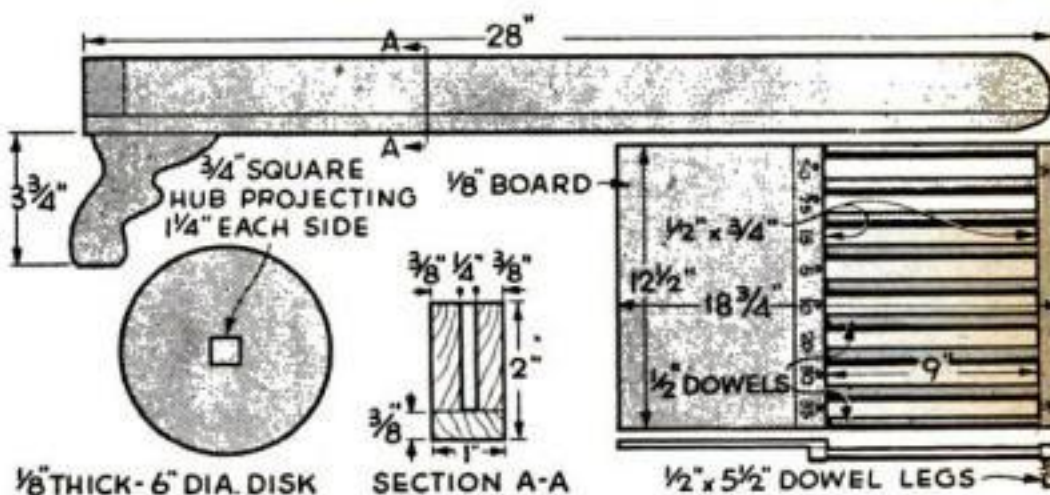
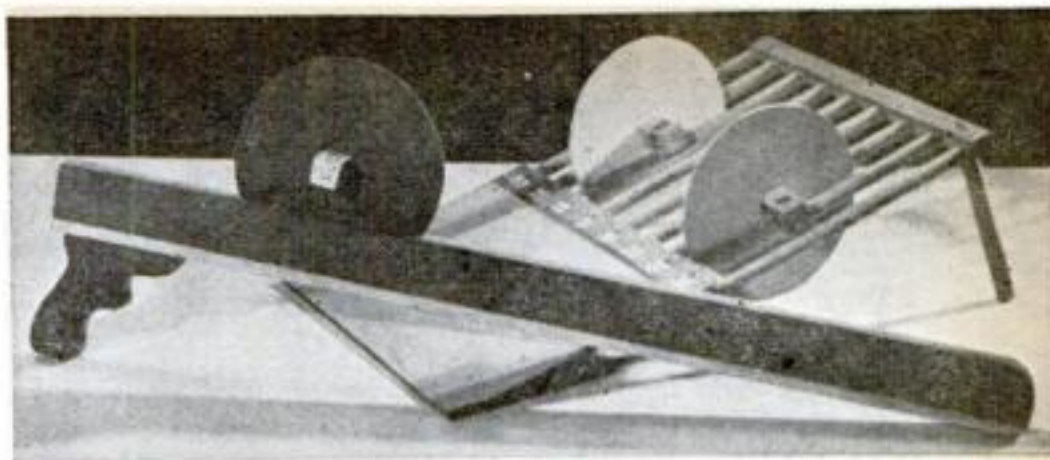
The piece may be stained and varnished, given a natural finish with clear varnish and well-rubbed wax, or enameled and decorated with decal transfers.—E. E. T.



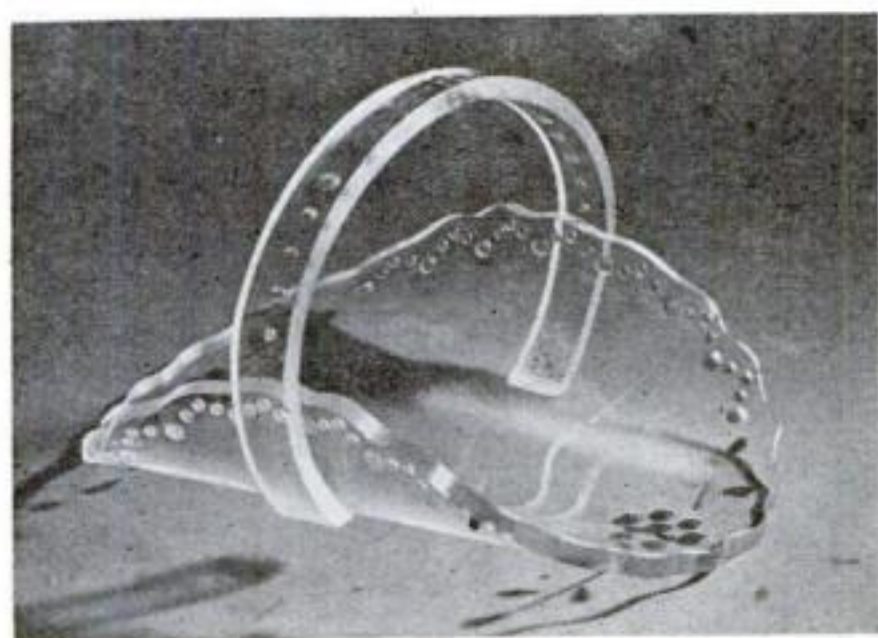
Luck and Skill Needed For Shooting-Disk Game

WITH a sharp eye and a steady hand you might be able to beat Junior at this made-for-Christmas game that's fun all year 'round. The disks are sped by gravity down an inclined gun and roll along the floor to the slotted target. Set the target at one end of the room. About 6' away, rest the end of the gun on the floor at an angle of approximately 35 deg. Then let each of the three disks roll down the gun. With luck, they will wheel into the slots.

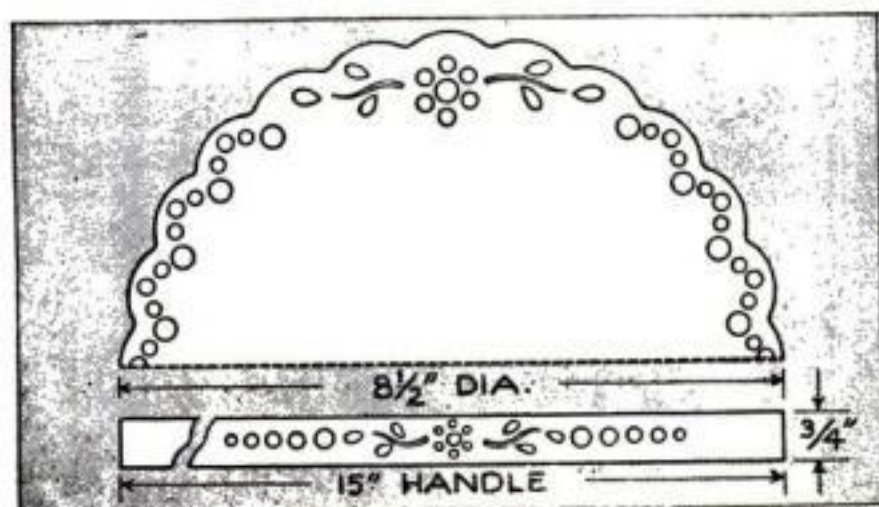
The score is computed from numbers on each slot and on the square hubs that support the disks in the slots. Number each slot in multiples of five, lowest in the center and highest for the edge slots. The sides of



the hubs are numbered 1, 2, 3, and 4. To secure the total score, multiply the uppermost hub number on each disk by the number of its slot, and add together. High man wins. Pressed composition board or plywood, dowels, and scrap wood are needed to make the game.—MYRON FLEISHMAN.



This useful candy and fruit basket sparkles with a flower design made by drilling holes halfway through and coloring the dimples. The pattern is below.



Clear Plastic Candy Basket Decorated with Blind Holes

COLORLED blind holes provide sparkling decorations for this clear plastic candy or fruit basket, pictured in color on page 117. By drilling halfway through the plastic with different drills, a simple flower design is created. Finishing touches like the stems and leaves are burred on with a hand grinding tool.

The basket section is made from an 8 1/2" circle of 1/8" or 1/4" clear plastic with scalloped edges. The handle is a 3/4" by 15" strip of the same material. To apply the coloring, wrap the tip of a round toothpick with cotton. Dip this swab in the color and twist around inside the holes. For this design, the flowers were tinted red, the leaves and stems green, and the edge holes yellow.

Shape the basket by heating in an oven at 250 deg. and bending so that the holes will be on the underside. The two ends with the flower decoration should remain flat. The handle is formed in the same way by heating and bending until its ends fit flat against the sides. Cement in place.—ELMA WALTNER.

What's New in HOME HEATING

Keeping warm in winter without a fire sounds impossible, but a new system offers just this.

By R. P. STEVENSON

HEATING engineers are giving new meaning to the old expression, "all the comforts of home." It wasn't so long ago that the development of various types of automatic heating began to banish the coal shovel and its attendant drudgery. Now the experts are promising us even more. Before long—as a matter of fact right now if you wish—you'll be able to discard not only your shovel, but the furnace fire itself.

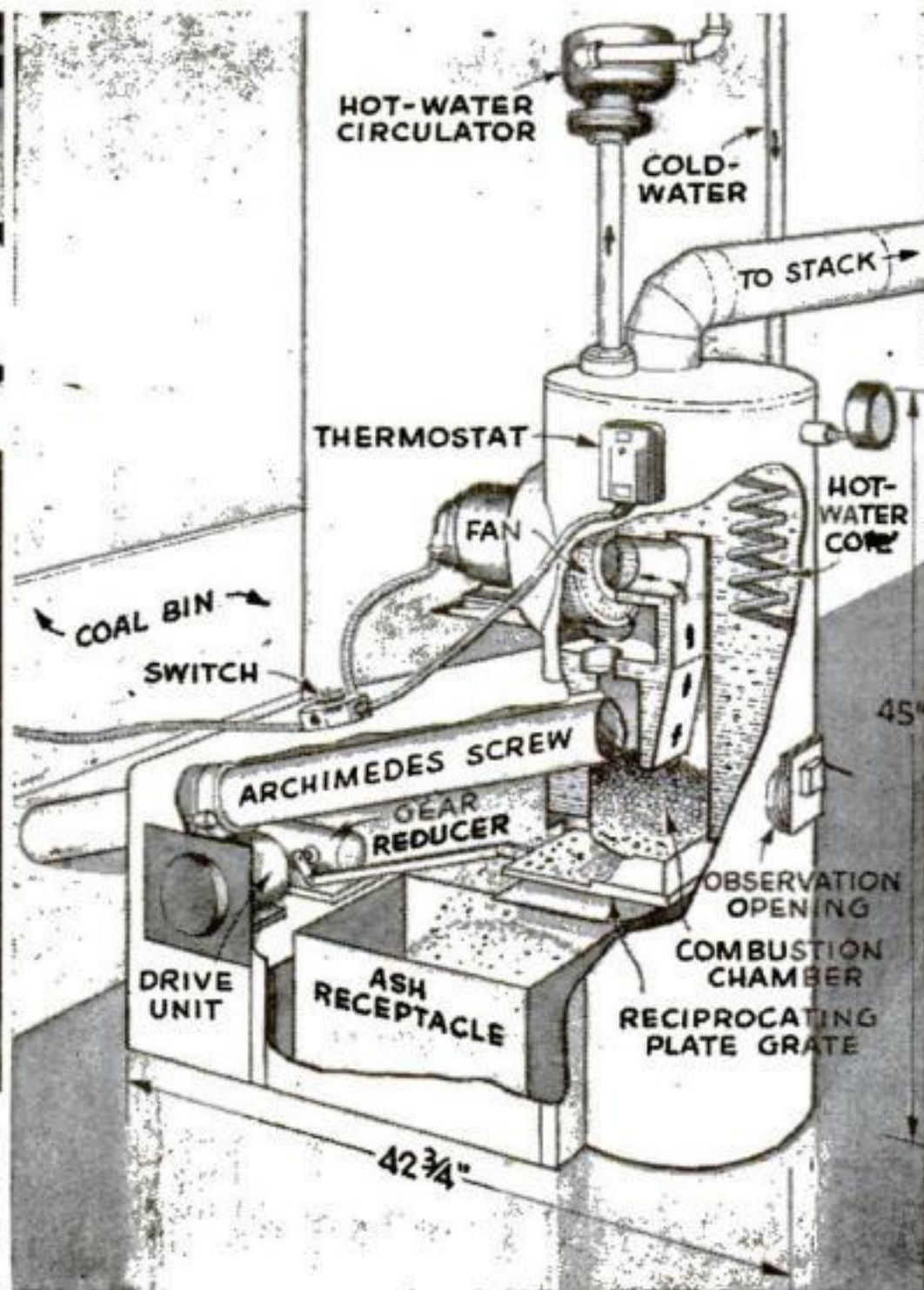
Historically speaking, heating a home without a fire is a major milestone. Always before, we have depended on the combustion of wood, coal, coke, oil, or other fuel to keep us warm. Now we can do it by expend-

ing electrical energy to pump into our homes some of the heat that is always present, winter and summer, deep under the ground. And strangely enough, the apparatus that does the job is little more than your electric refrigerator working in reverse.

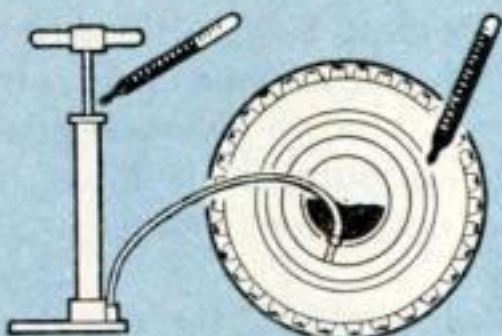
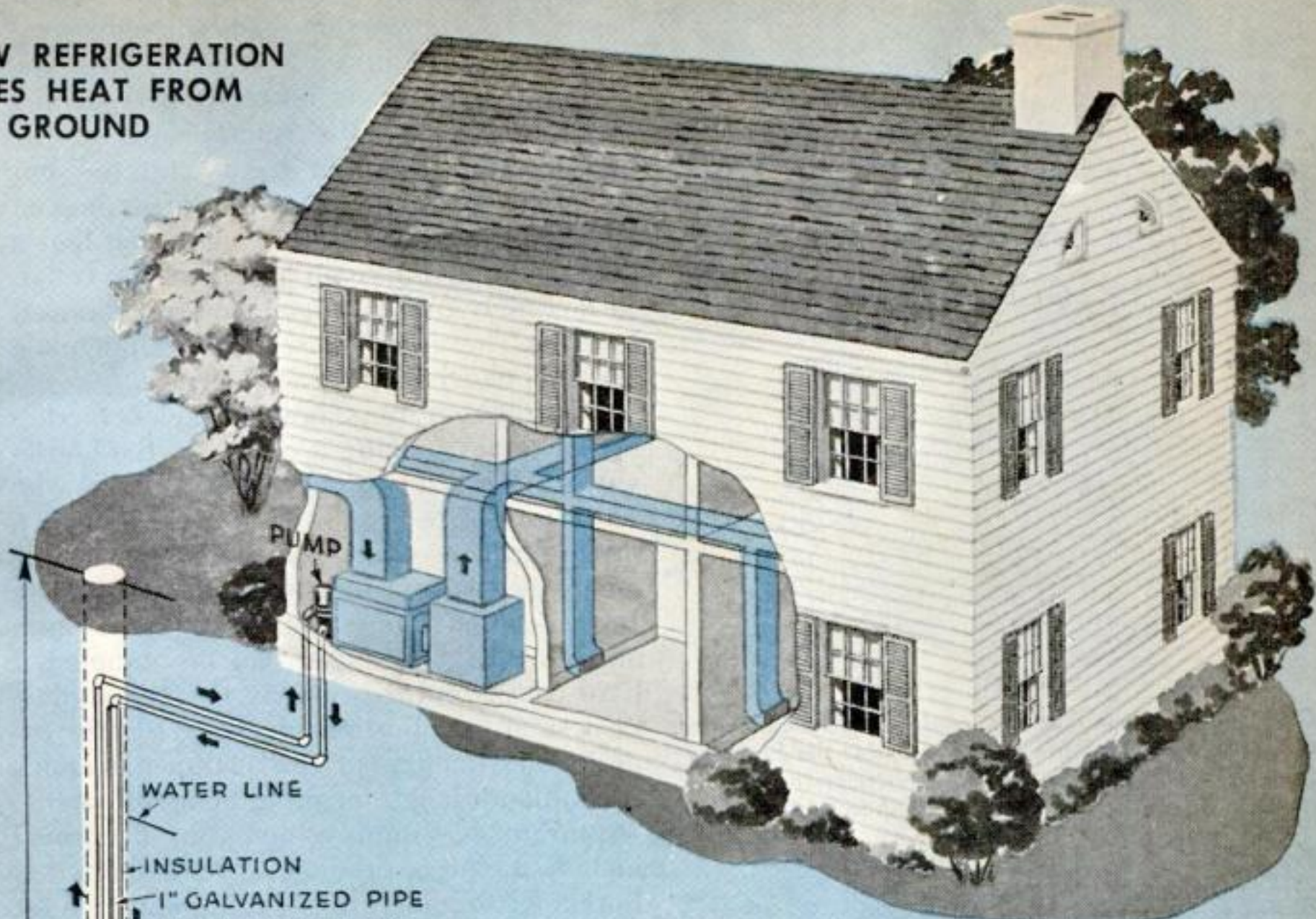
Nor is this the only break with tradition in the field of heating. In planning a new home, you can forget about a chimney—at least as a draft-producing device. Several types of furnaces now on the market, or soon to appear, create their own drafts and need only a vent in the wall. Neither do you need a cellar, since a small utility room, or even a closet, provides adequate space for one of the compact new heaters, whatever it burns. And by installing radiant heat pipes in the



This midget furnace burns hard coal in a fire chamber only 8" in diameter. It was developed from the Anthratube, a pipelike, experimental heater announced two years ago. Fuel is fed by an Archimedes screw.



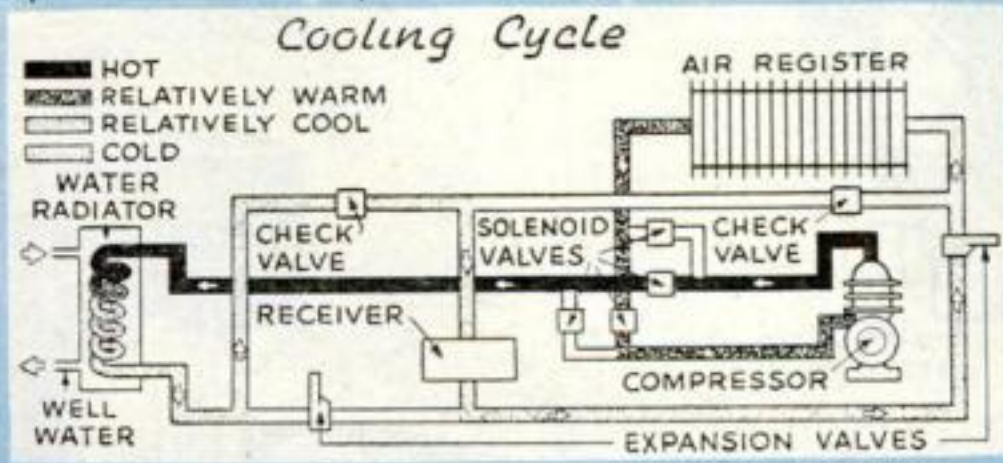
HOW REFRIGERATION TAKES HEAT FROM THE GROUND



1 Air pumped into a tire heats up because of compression.



2 Cooled while compressed, then released, the air is much colder.

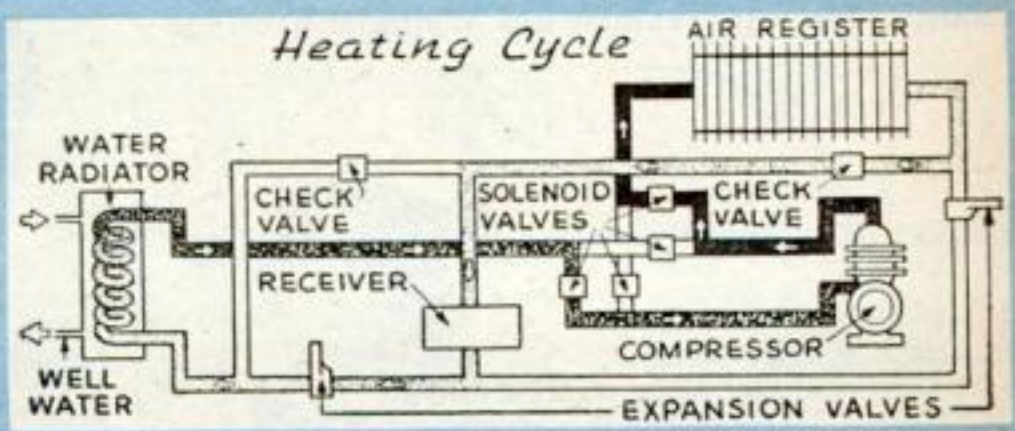


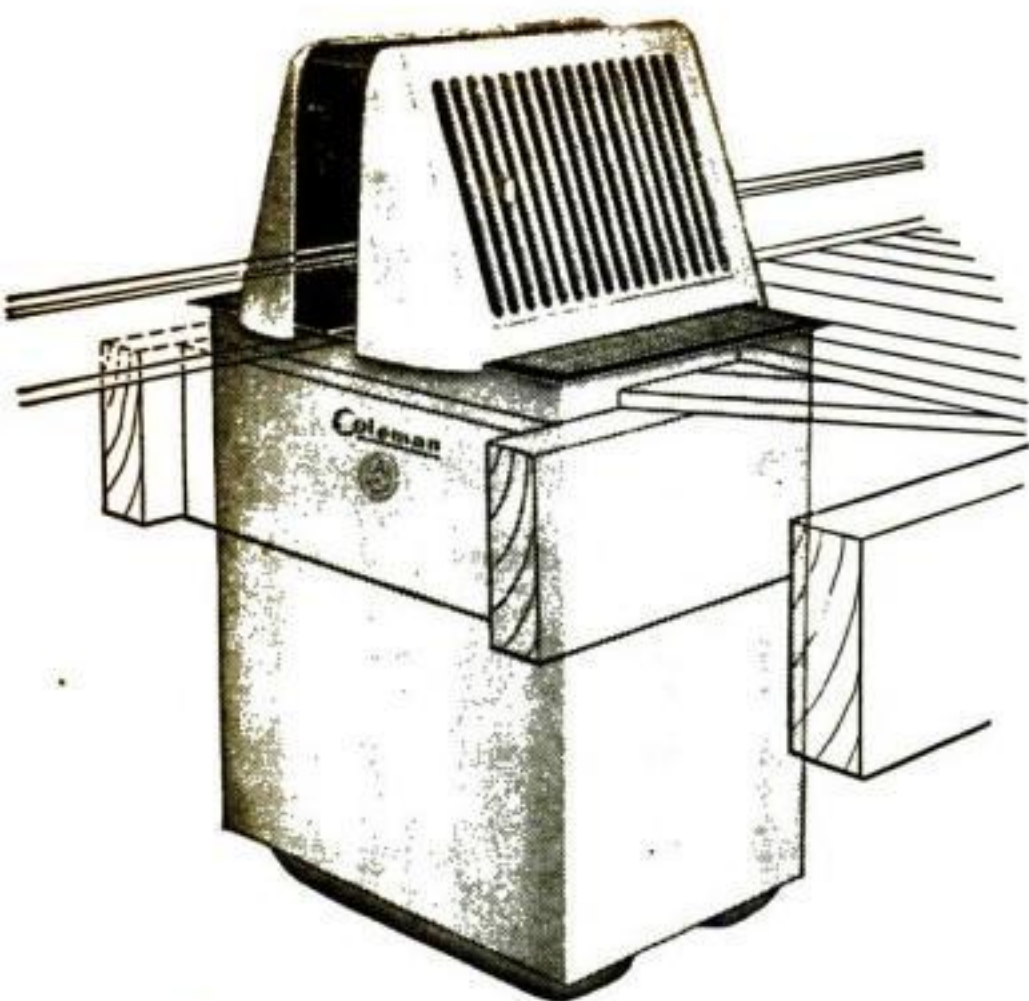
3 At left, the compressed refrigerant is cooled by well water. Then, allowed to expand in plates in the air stream, it takes heat from the house.

4 For heating, the cycle is reversed. Refrigerant takes heat from water, gives it to the house.

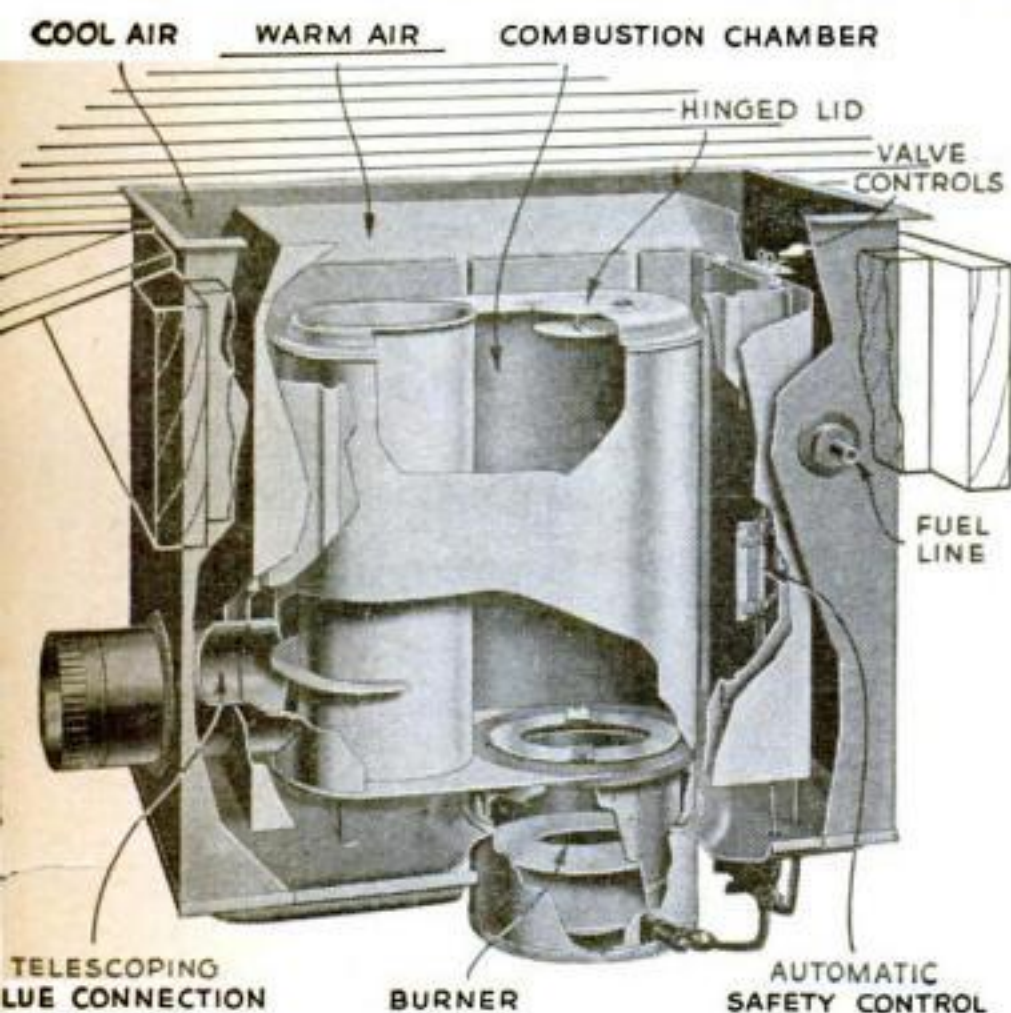


5 As tepid water cools a hot poker, but melts ice cubes, so the well absorbs or provides heat as needed.

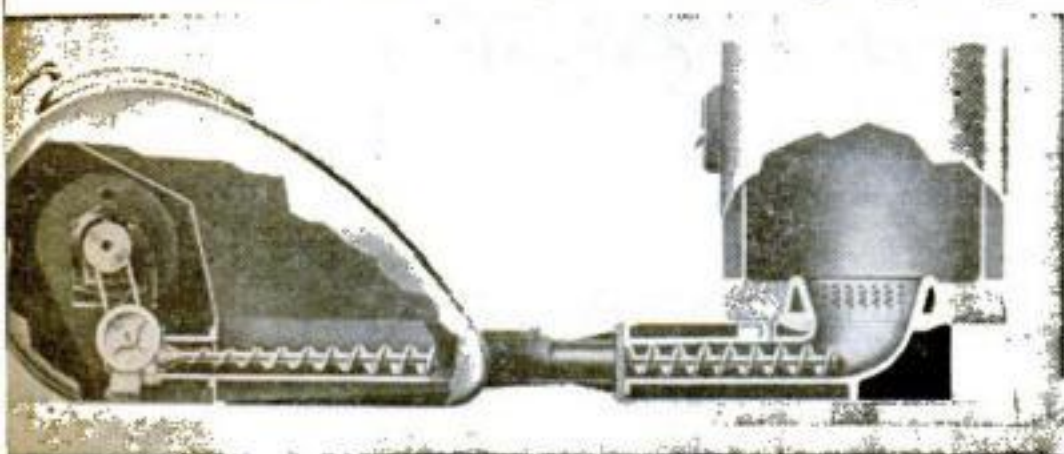




Oil-burning space heaters made by the Coleman Co., Wichita, Kan., are installed under the floor, as seen above and below. A similar heater that burns gas is produced by the Rheem company, New York.



Below is a stoker with a single cone-drive gear and pinion designed by the Stoker Drive Company, Frederick, Md., to replace old multiple gearing.



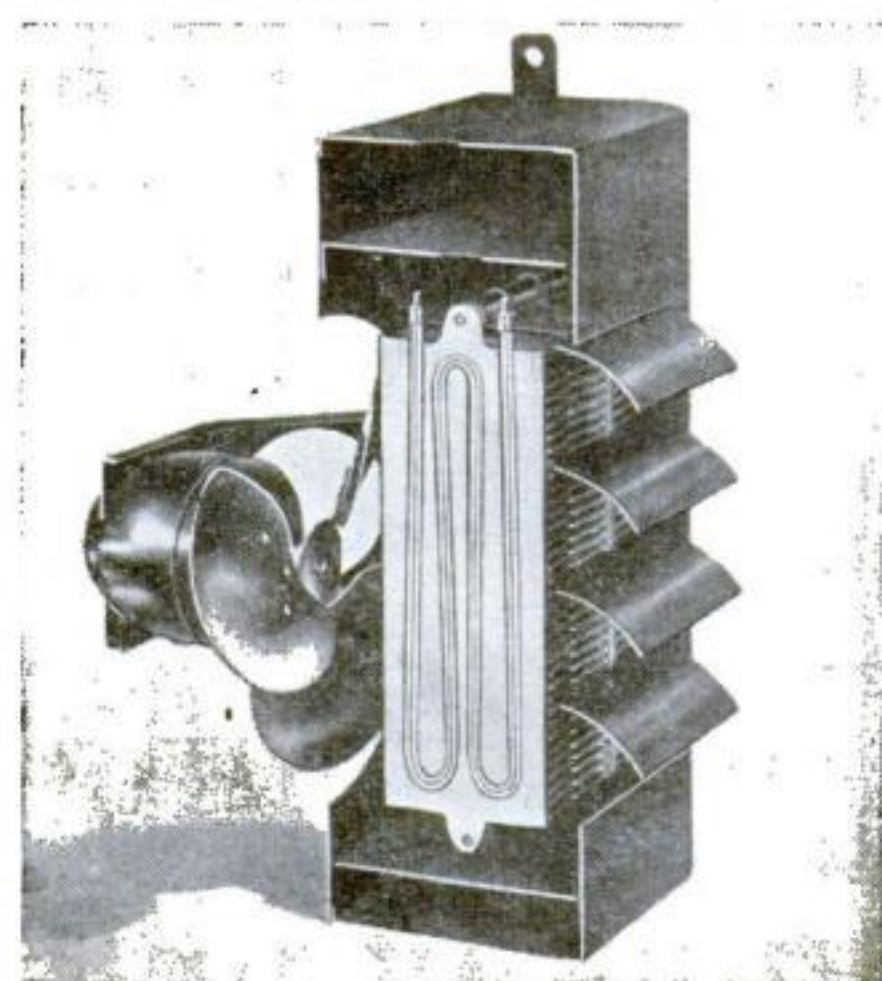
floors or walls, or by using the new radiant baseboards, you can eliminate the old space-consuming radiators.

In appearance, the heaters now reaching the market bear little resemblance to the ugly contraptions that have cluttered our cellars for so many years. More compact and better designed, they might well find a place in the living room instead of the cellar. In fact, new fuel-oil space heaters produced by Duo-Therm are based on Chippendale and Hepplewhite furniture designs.

For soft-coal users, new smokeless models are available, making it easier for the housewife to keep the home clean. Those who burn anthracite soon will be able to buy a midget furnace which puts to use a principle announced two years ago by the Anthracite Institute—that more complete combustion and greater heat output can be obtained if hard coal is burned quickly by forced draft in a small combustion chamber. Early experimental models of this compact furnace resembled a length of pipe; hence the name "Anthratube." Improvements in oil burners include a clutch, produced by the Gilbert & Barker Manufacturing Company, West Springfield, Mass., to prevent formation of heat-stealing soot in the fire chamber.

Both gas and electric refrigerators have been adapted to give you heat in winter and air conditioning in summer, the same automatic equipment being used in both sea-

Installed in a wall, the electric heater shown in cross section below has a fan to spread its heat. The resistance is sealed in an aluminum casting. Electromode Corp., of Rochester, N.Y., makes it.



sons. It is an electrical refrigeration system that will enable you to have heat without combustion, the refrigeration cycle being reversed and giving us the designation "reverse cycle heating." It also is called a "heat pump" because heat is transferred from one temperature level to a higher one.

During the past year, a commercial model produced by the Muncie Gear Works, Inc., made its bow in more than 100 homes in Muncie, Indiana. Marketed under the trade name of Marvair, this system is illustrated on page 153. It takes heat from the ground by circulating water in a closed pipe system, placed in a well of 4" or 5" bore drilled to a depth of approximately 200' below the natural water level. Aluminum pipe is used for the return leg because it absorbs heat better. Even in the northern latitudes of the United States, underground temperatures are surprisingly high. For example, around New York and Chicago the temperature is approximately 52 degrees at a depth of 30' to 60'.

The compressor of any refrigerator creates some heat directly, but this should not be mistaken as the source of the heat that warms a home in the reverse-cycle system. The compressor merely lends a helping hand to get heat from the ground.

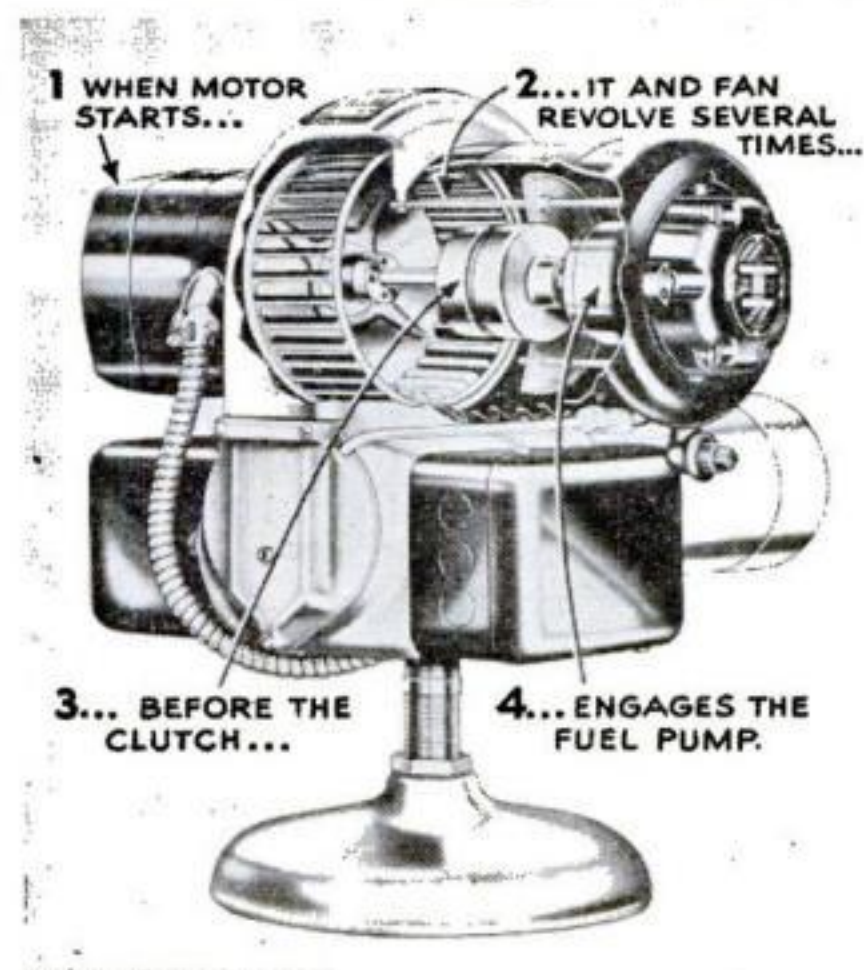
When the underground heat units contact the cold pipe, they are absorbed by the circulating water. Pumped up the pipe, the

water carries the heat units to a water radiator, where they again contact a colder fluid, this time the refrigerant. As before, the heat units go to the cooler region. Moving on to the compressor, the refrigerant is put under pressure. As in all cases where the pressure of a gas is increased, its temperature also goes up. Now compressed, the refrigerant travels to the air radiator, still carrying the heat that came from the earth. Once again the heat units seek a cooler region, this time an air stream on its way through ordinary ducts to the rooms that are being heated. There, they keep you warm.

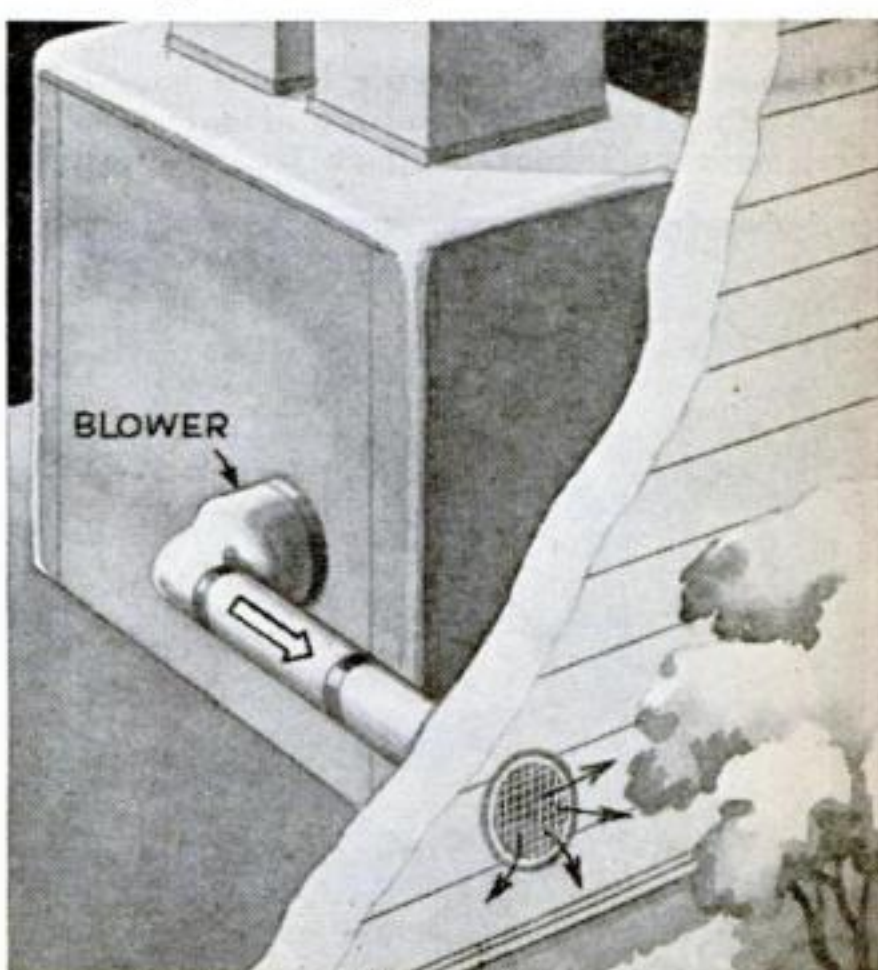
Operated like an ordinary refrigerator, the Marvair system also cools your home. But in this case, the transfer of heat is reversed—from the home to the ground. Automatic controls, including four solenoid valves, make the change from heating to cooling and vice versa as the need arises.

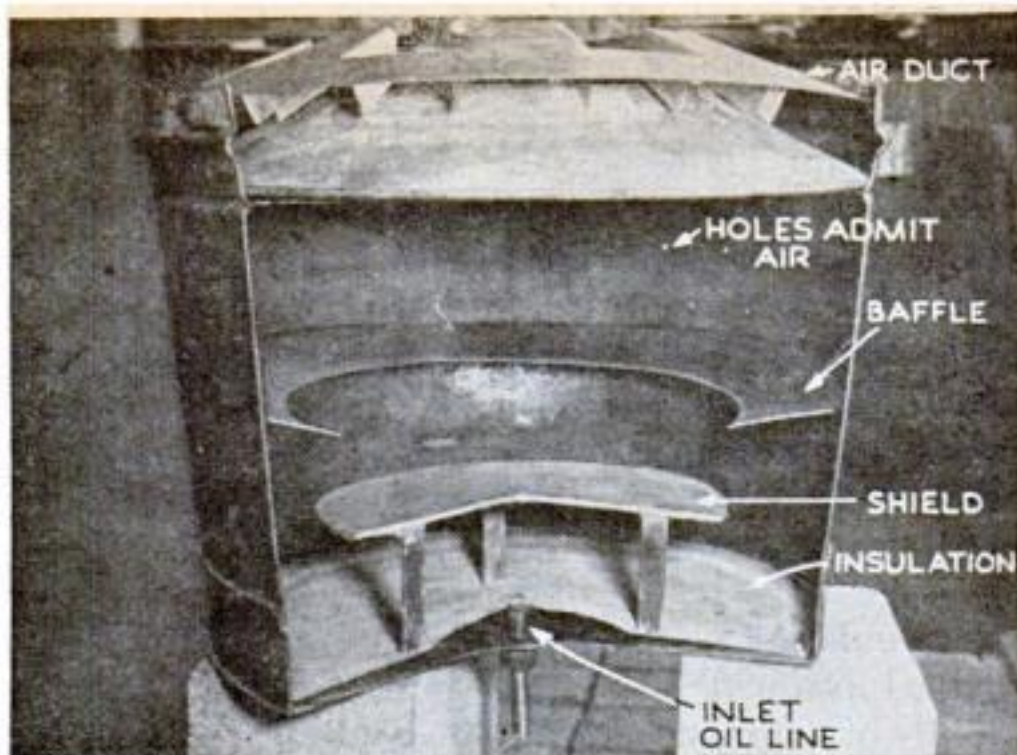
Anyone who has pumped up an automobile tire has observed the generation of heat, usually by feeling how hot the pump hose is. Air in the tire is also hotter than that outside, but if released from the valve, the escaping air is found at its original temperature. Now suppose that the compressed air is first cooled by placing the tire in a huge refrigerator. If you then allowed the air to escape, it would lose the same amount of heat it gained when the tire was pumped up, but since its temperature already is lower, it

In starting or stopping, most oil burners give off a soot-creating puff of smoke because enough air for complete combustion is not delivered by the fan. The clutch below is designed to prevent this.



Several heaters need only a simple vent instead of a chimney because they create their own draft. One of these is the new Norge oil furnace. It has a fan to pull air through the combustion chamber.



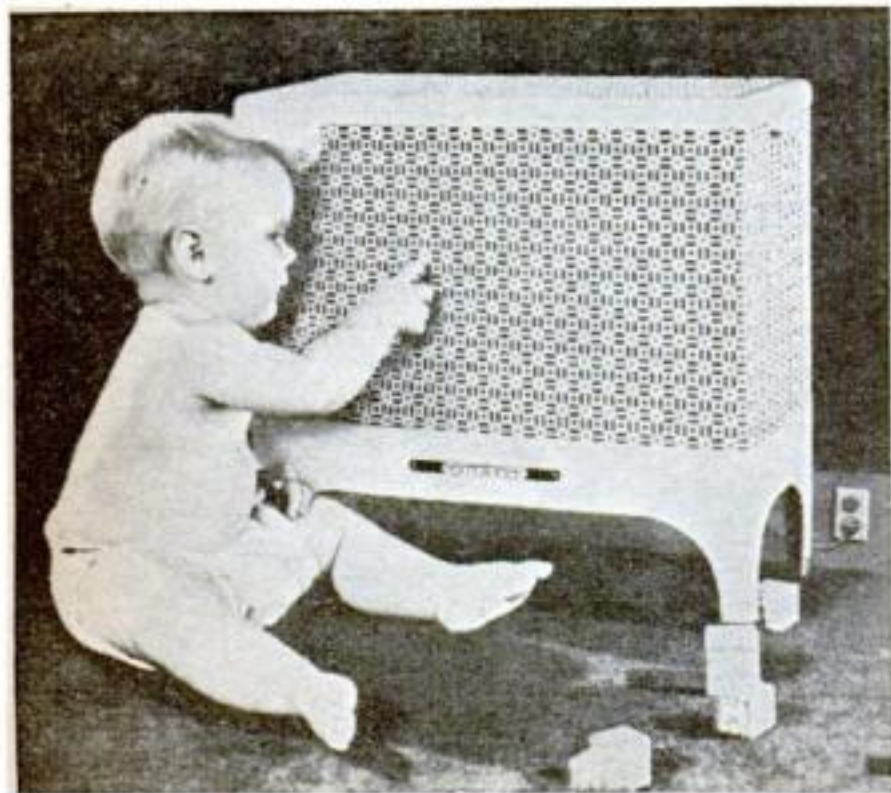


Ordinarily, pot burners require high grade oil because heat from the flame cracks a cheaper grade while it is vaporizing. Socony-Vacuum engineers now have developed a pot-type heater which prevents cracking, making it possible to use the more economical fuel. It is shown above under test and in a cutaway view.

would descend far below the original point.

This illustrates what happens in the cooling cycle of a combination cooling-heating system. The refrigerant, heated by the compressor, passes directly to the water radiator. Since the refrigerant at this point is warmer than the water, it loses heat to the water; that is, the refrigerant is cooled as the air was in the tire example. Consequently, when the refrigerant passes through the expansion valve, it loses the same amount of heat it took on in the compressor but it goes below its original temperature by the same amount it gave up in the water radiator. Continuing on to the air radiator, the refrigerant then extracts heat from air circulating in the home. When the home needs heat, exactly

Designers of portable electric heaters have made them safer. Even a baby faces no danger from this one, made by Trilmont Products Co., Philadelphia.



the reverse occurs, the water giving heat.

Although current models of the Anthra-tube no longer resemble a length of tubing, the advantage of compactness has been retained. The automatic hot-water unit illustrated on page 152 has a boiler 16" in diameter and 45" high and, with the automatic feed mechanism, the entire furnace occupies a floor area only 20" by 42 3/4".

Combustion takes place in a chamber only 8" in diameter, but the suction draft created by a fan produces an extremely hot fire. Fuel feeds from the bin through an Archimedes screw. Since the coal falls from the screw to the firebed by gravity, feeding stops when the combustion chamber is full—even though the tube continues to turn at its normal rate of about 15 r.p.m. A crank and connecting rod from the reduction gear operate the grate horizontally at the rate of one 2" stroke a minute. This shears off the ash, allowing it to drop into a removable ash receptacle below.

A thermostatic-type switch controls the position of the fire as well as the operation of the fuel and ash-removal mechanisms. Located so that it is sensitive to the temperature of the lower section of the firebed, this bi-metal switch turns on the motor, setting the Archimedes screw and grate in operation, when the coal in the bottom of the bed has been consumed and the ash begins to cool. After the ashes have been ejected and hot coals take their place, the increased temperature shuts off the switch and the motor stops. If the fire should go out, another control cuts out the entire mechanism and prevents unburned coal from being wasted.

WHAT'S YOUR INGENUITY QUOTIENT?

IQ

MUSIC HAS CHARMS to soothe the restless baby. Mine is apt to wake up crying for reasons that only he understands. A music box under his crib seems to be the perfect pacifier. At the first bellow I turn it on and let the faint tinkle waltz him back to sleep.—JAMES CARPENTER.



ARE YOU A PIGGY-BANK SHAKER? I can't trust myself when my back is turned, so I bury my loose change in any empty oil can. A length of pipe chutes the coins into the can, and a rubber collar around the opening keeps the ground moisture from seeping in.—GEORGE L. PAYNE, JR.



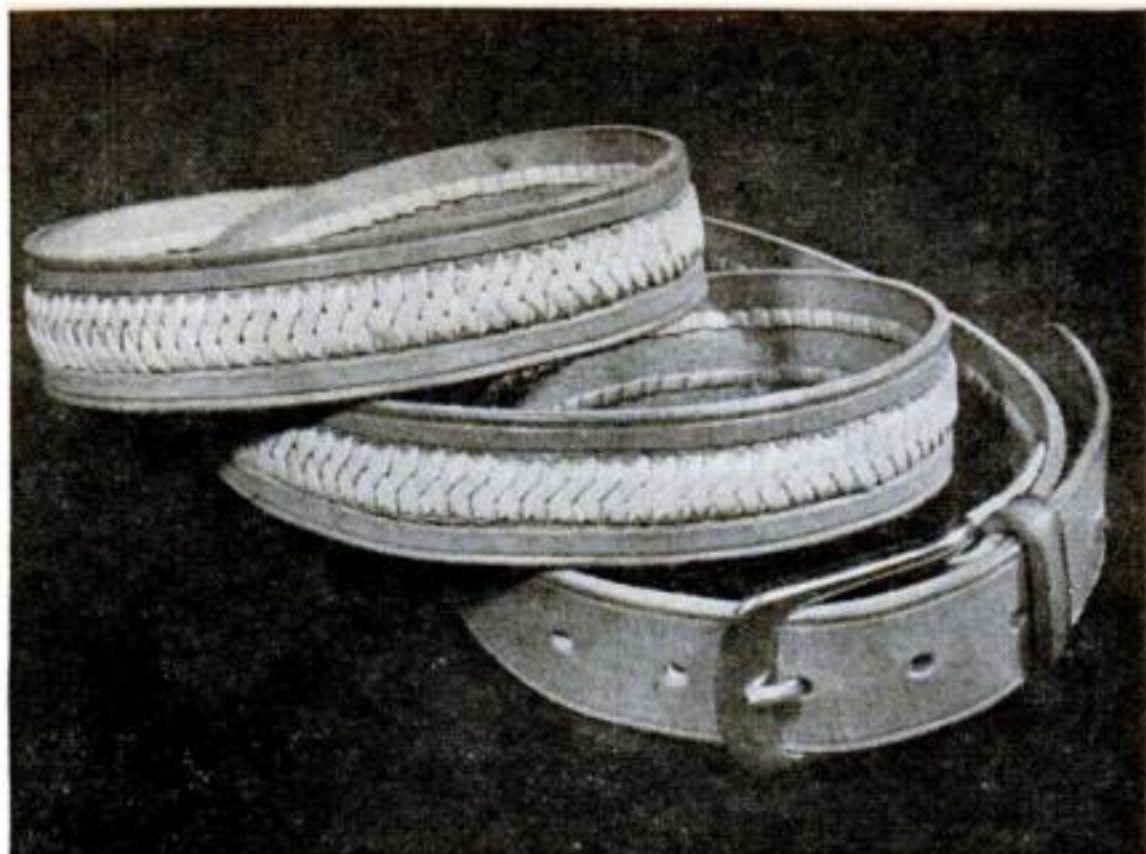
Have you pulled off a smart one lately? We will pay for acceptable contributions showing ingenious solutions of problems in the home, shop, garage, or camp. It doesn't matter if it's wacky—if it works.



YOU'RE AT YOUR ROPE'S END when it begins to fray. This brings out the Scotch in me, so I twist the frayed ends tightly and serve them with Scotch tape. In return pieces so salvaged serve me for everything from emergency shoelaces to apron strings.—A. H. STEVENS, JR.



WELL, FLAP ME DOWN! That's the way I felt when I held a phonograph album wrong side up and the records slithered out of their sleeves. Now I've pasted cardboard flaps over the envelopes, so no matter who does what to them, the disks stay put within, snug and safe.—JAMES ROBERTS.



LACED LEATHER BELT . . . GAUCHO STYLE

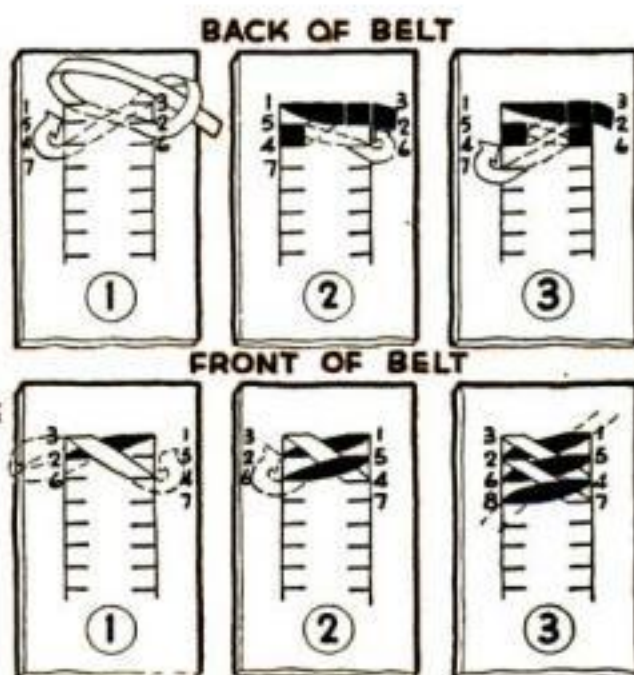
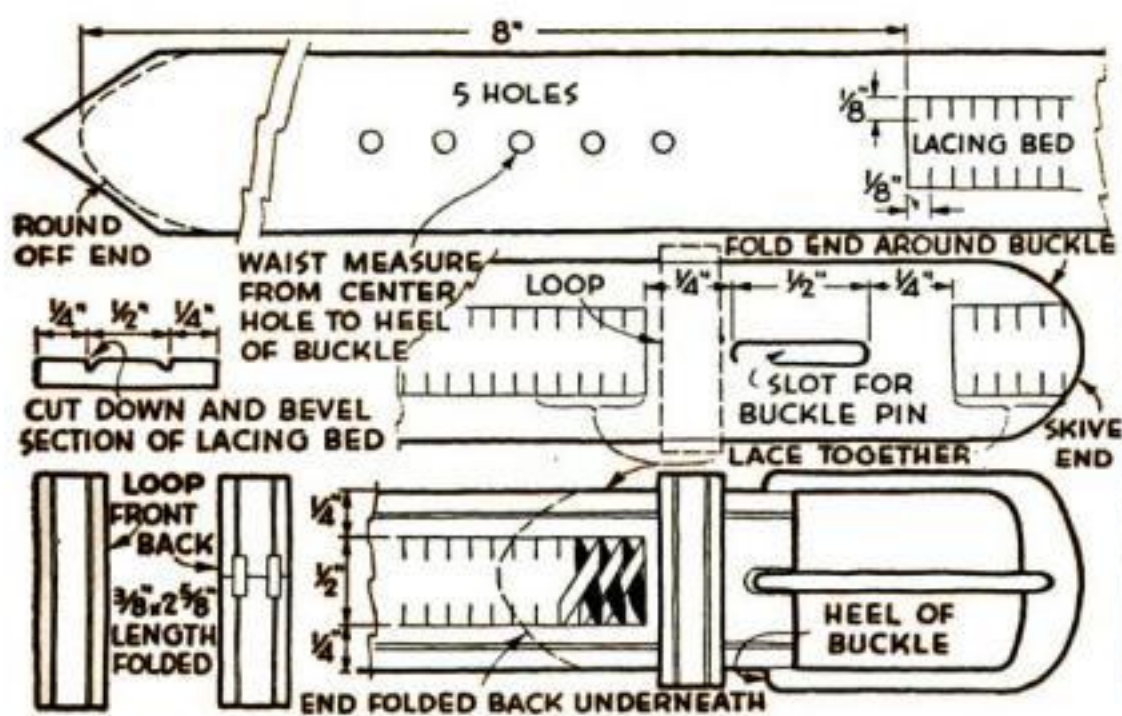
HARD-RIDING gauchos no longer rule the wide Argentine pampas. But the fine leather handicraft developed by these South American cattle punchers has been preserved, unlike the lost craftwork of our own cowboys, in government museums. From examples of their handsome bridles, knife handles, and other gear can be copied details like the typically gaucho "costura" braidwork that decorates the belt above.

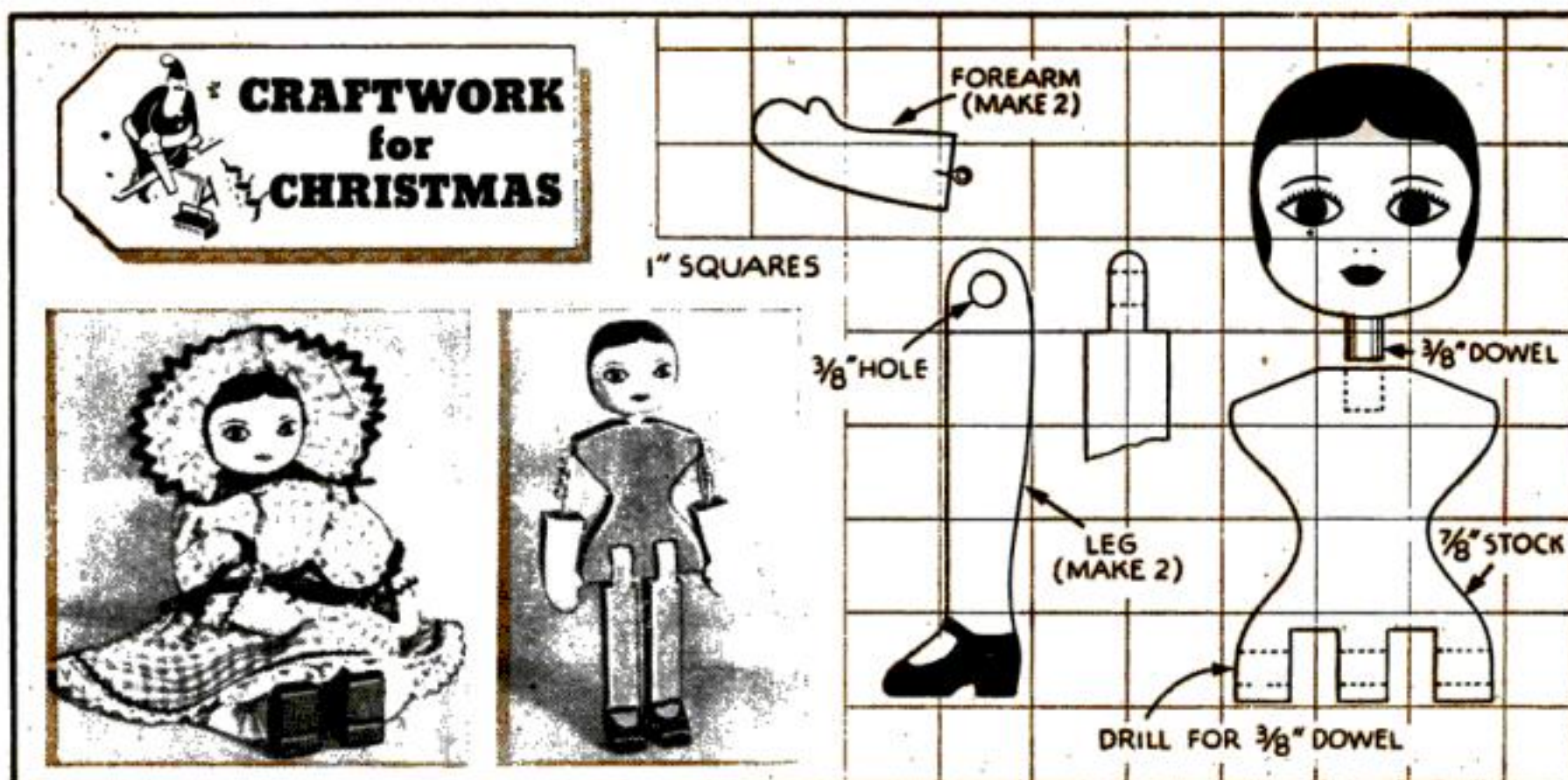
To make this, you will need a piece of belt leather 1" wide and several inches longer than your waist measurement (see drawing), a buckle, and 1 yd. of $\frac{1}{8}$ " leather thong for every 3" of braid. The plastic or fiber lacing employed for whistle lanyards might be used in place of leather, and the braidwork could be added to an old belt, if desired. Contrasting colors are most effective; the gauchos themselves preferred

to use white costura applied to a black belt.

Depressing the braid in a "bed" improves the appearance. Dampen the belt, and when it has dried so that no moisture can be squeezed out of it, mark the bed area and cut along the two sides to one third depth. Next bevel inward with a tap beveler. After the belt has thoroughly dried, lay off the holes $\frac{1}{8}$ " apart. Punch them with a single-pointed thonging chisel or a nail filed sharp.

Now begin lacing the braid by passing the thong, its point stiffened with glue or held in a lacing needle, through hole number 1 from the back to the front, and continue through the numbered sequence shown in the drawings. At the buckle end, the braid goes through two pieces of the belt at once to hold on the buckle. Finally, tap down the lacing and finish to a soft sheen with saddle soap.—BRUCE GRANT.





Wood Doll of Covered-Wagon Days Has Movable Arms and Legs

QUAINT wooden dolls whittled painstakingly by fathers and dressed by mothers made many a trip across the plains in the days of the covered wagon. This "modern" old-fashioned miss will be no less cherished by a little girl this Christmas. Instead of being whittled, its body and movable arms and legs can be sawed out with power or hand tools; its head is a turning or a wood ball.

Make the parts of hardwood and round the edges. Drill the hips for a hardwood

dowel; then round the ends of the legs until they move freely on it in the notches. The forearms hang on stout cord knotted through small screw eyes or held with staples.

Shellac over the wood provides a natural complexion. Paint in features, hair, and shoes with enamel to which a few drops of clear varnish have been added.

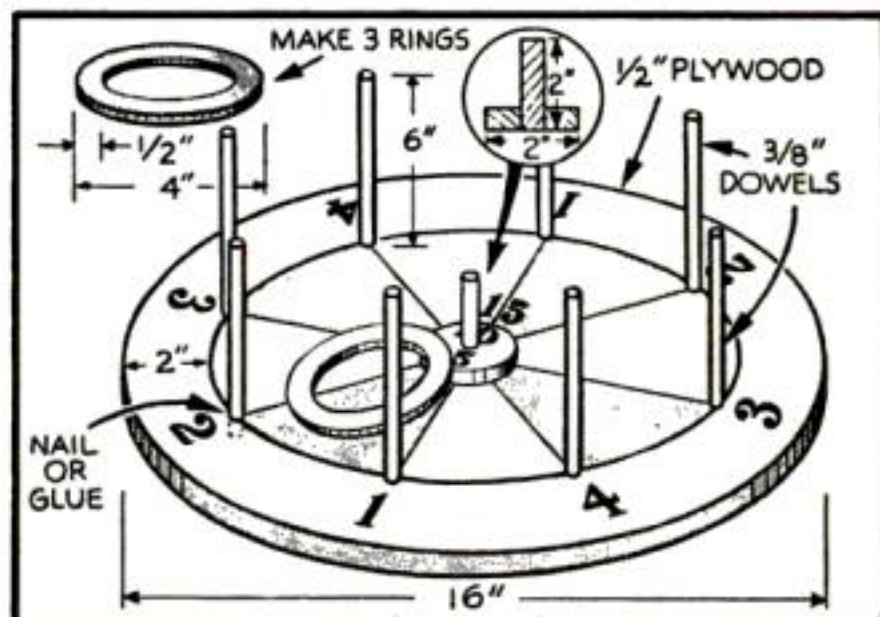
The doll wears long pantalettes, the traditional one-piece dress with kimono sleeves, a sash, and a bonnet.—DORIS ALLER.

Ring-Toss Game for Table Play

HERE is a ring-and-peg game for indoor play on rainy days. The base is $\frac{1}{2}$ " plywood, as is the glued or nailed center disk with the short peg. Mark the base radially and paint the spaces black and light blue alternately; then number the long outer pegs 1 to 4, the disk 5, and the short peg 10. Cut three rings from 14-ply show-card stock.

Note that the short peg is driven into a hole in the center of its disk and not into the board itself, while the outer pegs are put in holes drilled in the board.

Players stand 4' from the board, and their score is what they ring. When two rings go over one peg, the number counts twice; but if three go over a long peg, the entire score is wiped out. A third ring over the short peg counts. Rings tilted on the center disk without going over the peg count 5; those that fall cleanly around the disk as well as the peg count 15.—DONALD W. CLARK.



Tom Thumb CRAFTWORK



Monkey wrenches resting on a penny. At left, actual size; above, three times enlarged.

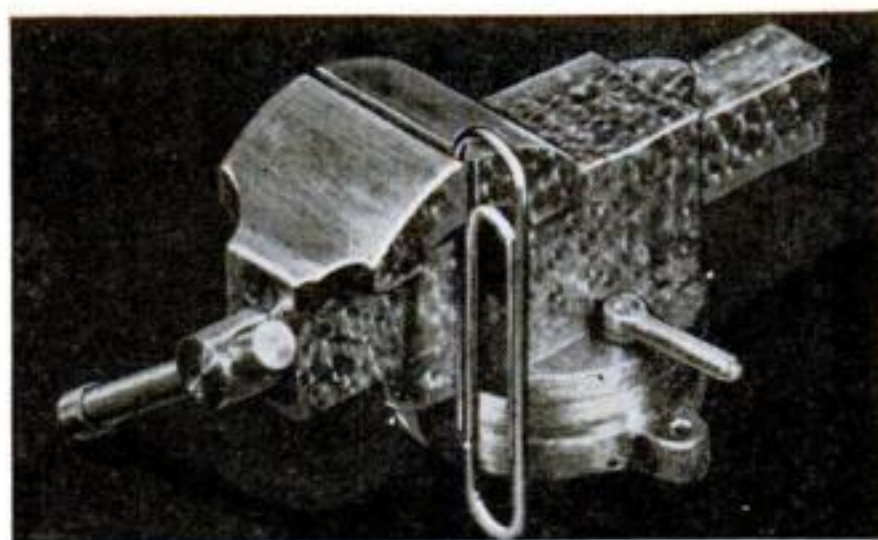


Every part of this model surface gauge works as in the standard tool. The little vise shown holding a paper clip below is only $2\frac{3}{8}$ " long.

NO MATTER how small the finished work is to be, skilled modelmakers pride themselves on faithfulness to detail and scale. A. F. Hofmann, of Ridgewood, N. Y., followed that cardinal rule in making the tiny tools in the photos above and at right, and so did Amy Elizabeth Jensen, of Wausau, Wis., in fashioning the Lilliputian furniture shown below.

Both miniature monkey wrenches have movable jaws. They are models of the same 13" wrench, one at a scale of 1" to 1' and the other at a $\frac{1}{2}$ " scale. The surface gauge, half the size of the smallest on the market, is reduced exactly to scale in every detail.

Most of the vise was made on a milling machine, but a lathe, of course, was required for the screw. Swiveling on its base, the vise can be locked in any position. It

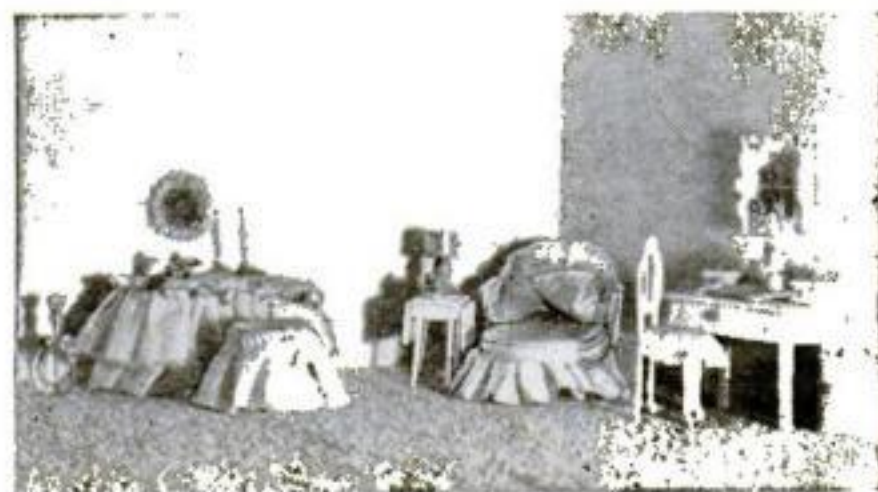
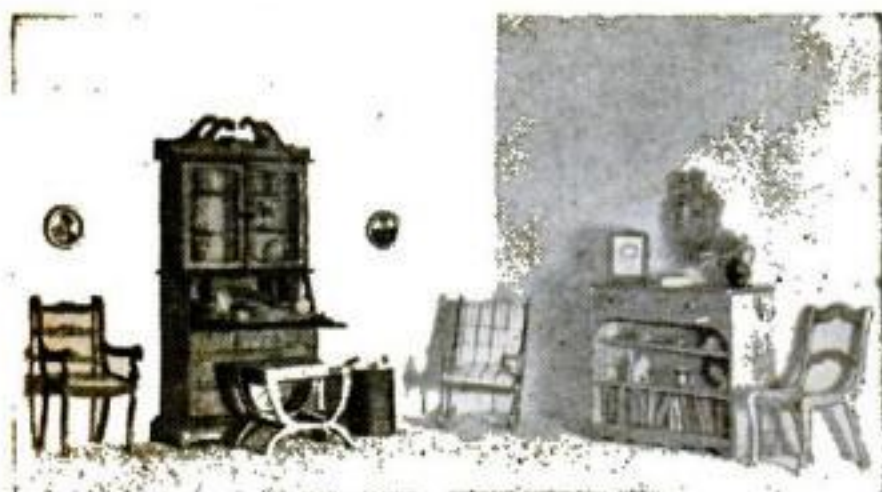


measures only $2\frac{1}{32}$ " by $1\frac{3}{16}$ " by $2\frac{1}{8}$ ".

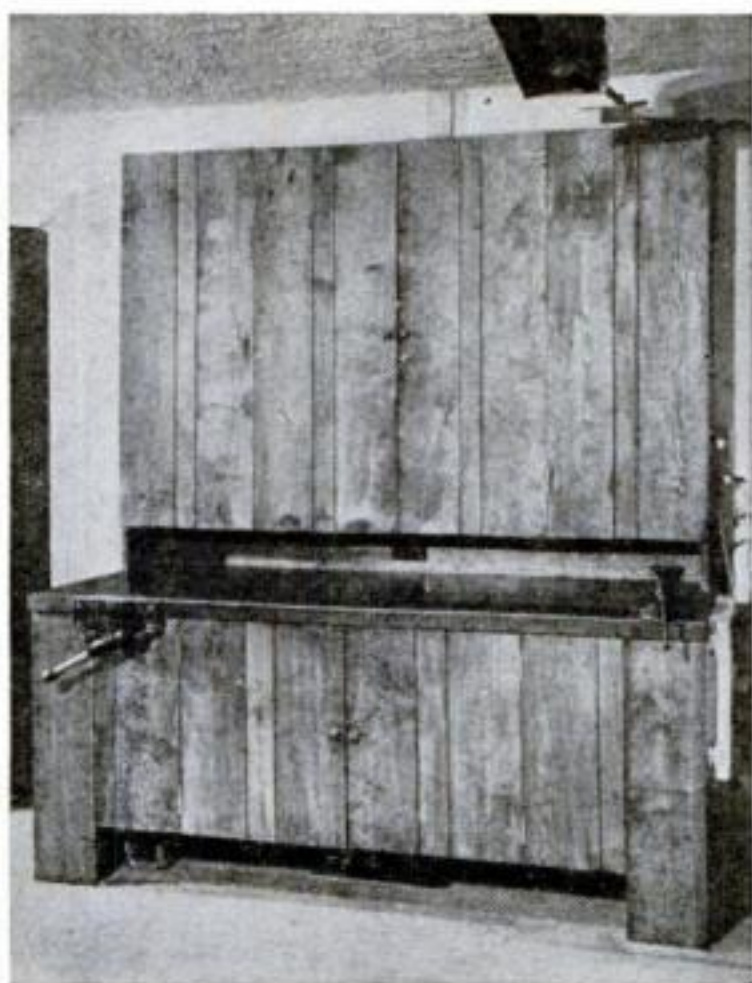
The model furniture is a size suitable for doll houses. It is made from plywood and other scraps, and the accessories from discarded materials. Though much is copied, the work leaves room for original design.

Model furnishings of doll-house size are faithful copies of antique pieces on a scale of $1\frac{1}{4}$ " to 1'.

The accessories for this miniature dressing room were made from bits of discarded odds and ends.



This cabinet conceals a complete assortment of woodworking equipment. Ample bench space is provided by a smooth-surfaced top.



Workbenches in Dress Suits

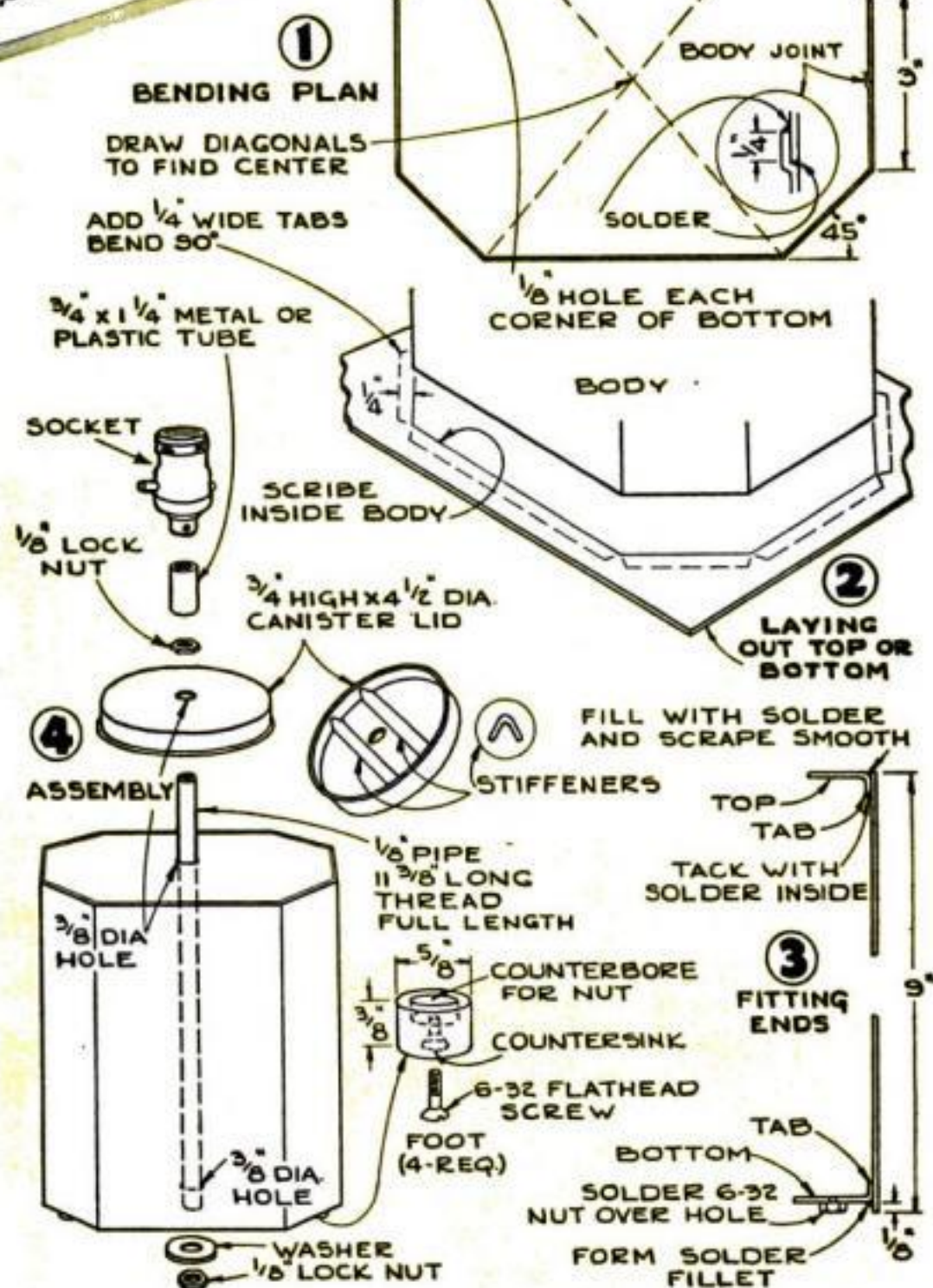
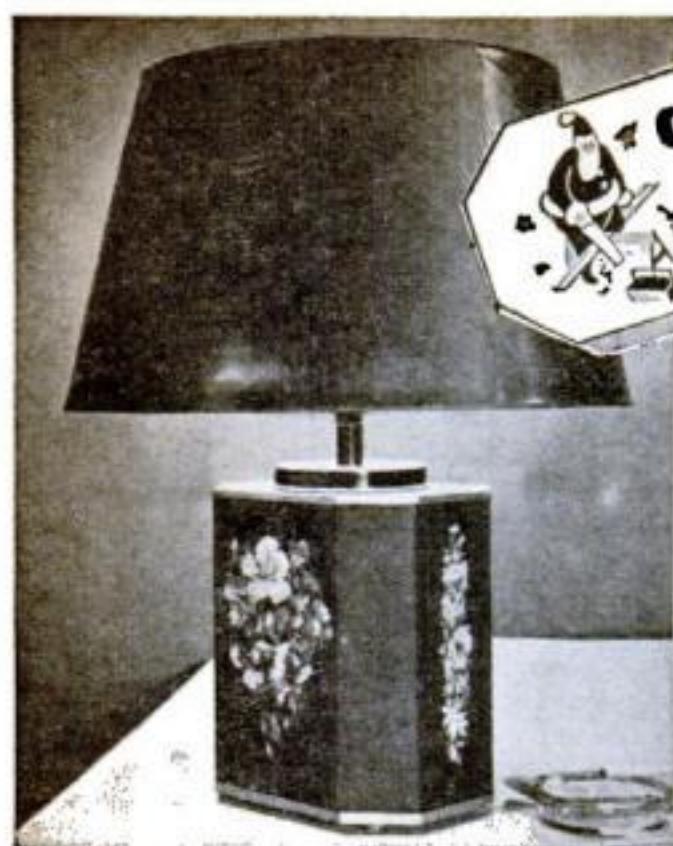
CRAFTSMEN who object to working in the cellar can move into a rumpus room or even the parlor by concealing workbenches in handsome cabinets and tables. As shown by these samples, such dressed-up benches are not only good looking, but their orderliness simplifies work.

For the compact yet exceptionally roomy cabinet in the photographs above, Sydney Oshrin, of Huntington, N. Y., made a frame of bolted two-by-fours. The workbench top is $\frac{3}{4}$ " composition board glued on 2" by 10" planks, while other parts are $\frac{3}{4}$ " pine finished with walnut stain. An organized system of storage adds to convenience. Jars of nails, nuts, and bolts are in front, with saws, electric drill, and other large tools above. The right door holds screwdrivers, chisels, and hammers; the left files, pliers, and bits.

At right, a modern table camouflages the workbench of Parker E. Hart, of New York City. A hinged whitewood cover and plywood sheathing hide working parts scavenged from several old pieces—pedestal drawer sections of an old desk for the sides, a filing cabinet for the center, and a carpenter's workbench top.



Lowering the hinged cover on the workbench at the right converts it into a living-room table. Even the vise, set in a recess, is entirely hidden.



Painted METAL Lamp

RESEMBLES OLD TÔLE WARE

A PROJECT that lends itself well to decoration with transfers is a sheet-metal lamp. The one shown here and in color on page 117 was made of extra heavy tin plate, enameled, and trimmed with decalcomanias and gilt borders. It resembles the lacquered tôle ware, or painted pewter and sheet iron, that was popular in Holland, Belgium, and France in the eighteenth and nineteenth centuries.

On a 9" by 24 $\frac{3}{4}$ " piece lay out the corner bends called for in Fig. 1. With a bending

brake or by clamping the stock between two iron bars or angle irons, form 45-deg. bends along the scribed lines, taking care to keep them all parallel. The extra $\frac{1}{4}$ " strip at one end is offset as shown to form a flush joint. Solder inside and outside the seam; then scrape the outside smooth.

Place the eight-sided body so formed on another piece of stock and scribe around inside each end to mark out the top and bottom of the lamp. Do not cut on the scribed lines, but on others drawn $\frac{1}{4}$ " outside them,

as in Fig. 2. Cut out and bend the tabs thus formed at 90 deg. to fit inside the body. Tack the top with solder from the inside; then fill the joint with solder from the outside and scrape smooth to a sharp 90-deg. angle. The bottom can be soldered only from the outside, so use plenty of solder to form a fillet, as shown in Fig. 3.

Find the center of each end by drawing diagonals and drill a $\frac{3}{8}$ " hole there. Drill a $\frac{1}{8}$ " hole midway of each corner panel and $\frac{3}{8}$ " from the edge in the bottom. Over each of these four holes, solder a 6-32 nut, as in Fig. 3.

Four feet are next cut from $\frac{3}{8}$ " dowel, and then drilled, countersunk, and counterbored. They are held on by 6-32 flathead bolts.

A lid from a kitchen canister or a press-top can, a small metal bowl, or even a pie tin may be used to distribute the strain over the top. It is best to reinforce this member by soldering V-shaped sheet-metal stiffeners inside as shown in the drawing.

The upper lock nut is turned up against this, a metal or plastic tube slipped over the nut, and the socket threaded tightly against the tube. Then the lamp cord is run through the pipe and out under the bottom. If desired, a double cluster fixture may be mounted instead of a single socket. The lamp can be weighted by pouring sand in through the top hole after inserting the $\frac{1}{8}$ " pipe in the bottom hole.

For a neat trim to the enameled surface, the edge of the canister lid and the feet may be painted a bright contrasting color. Gilt edging, as on the lamp shown, may be put on cleanly by the use of masking tape. Transfers may be applied to all eight sides or to the four widest panels only. A coat of varnish over all, followed by waxing, will protect the decalcomanias.

If a single lamp is used, the shade can be mounted on a harp screwed on the socket, as in the photos. A brass or plastic finial completes the effect.—HARRY WALTON.

A Roomy Wooden Pirate's Chest to Hold a Child's Treasures

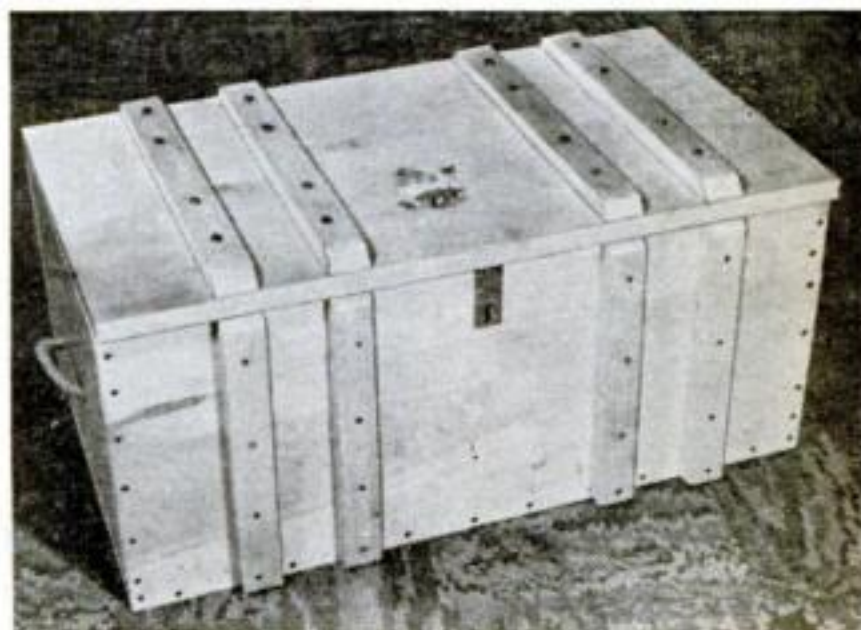
NEATNESS in putting away toys and the like is an easy habit to teach children if it is made into a game. This pirate's chest, especially if it is fitted with a hasp and a simple padlock a child can work, will appeal as a place to store "treasures."

The chest shown is poplar with a pine top and pine cleats, but any stock on hand will serve. It should be $\frac{3}{4}$ " thick to make the chest sturdy enough to withstand moving. The chest shown, a good size for the small playroom, is about 15" wide by 30" long and 12" deep.

Put the box together with nailed or screwed butt joints. Wood of full width will save work but may be hard to obtain. Since cleats give sufficient support, narrower boards can merely be jointed with a plane to avoid cracks; but a more workmanlike job will result if the edges are rabbeted or doweled and glued and if glue is also used in the butt joints before nailing.

In matching boards for lid, sides, and bottom, warping can be offset by alternating heart and sap sides. It is also well to put the cleats on with the concave side next to the boards and to nail from the center outward.

Use small-headed nails or screws, covering them with upholstery tacks driven in close by for a studded effect. Apply a decal and finish with varnish and wax.—ELMA WALTNER.





Carving these primitive heads is the avocation of Leo Whelan, repair-shop foreman for the Tucson, Ariz., bus system. At right he uses a small auger for shaping the deep undercut around the eyes.



Wood Sculpture with a Penknife

LEO WHELAN just likes to carve these distorted faces. During business hours he's repair-shop foreman for the Tucson, Ariz., bus system, but in his spare time he whittles primitive heads and animals from wood blocks.

Whelan's free-hour work is art for art's sake. He sells none of it. Most of the figures are purely decorative, although he has made a few functional pieces, such as a lapel pin with a painted African face, and

a penholder in the form of a small deer.

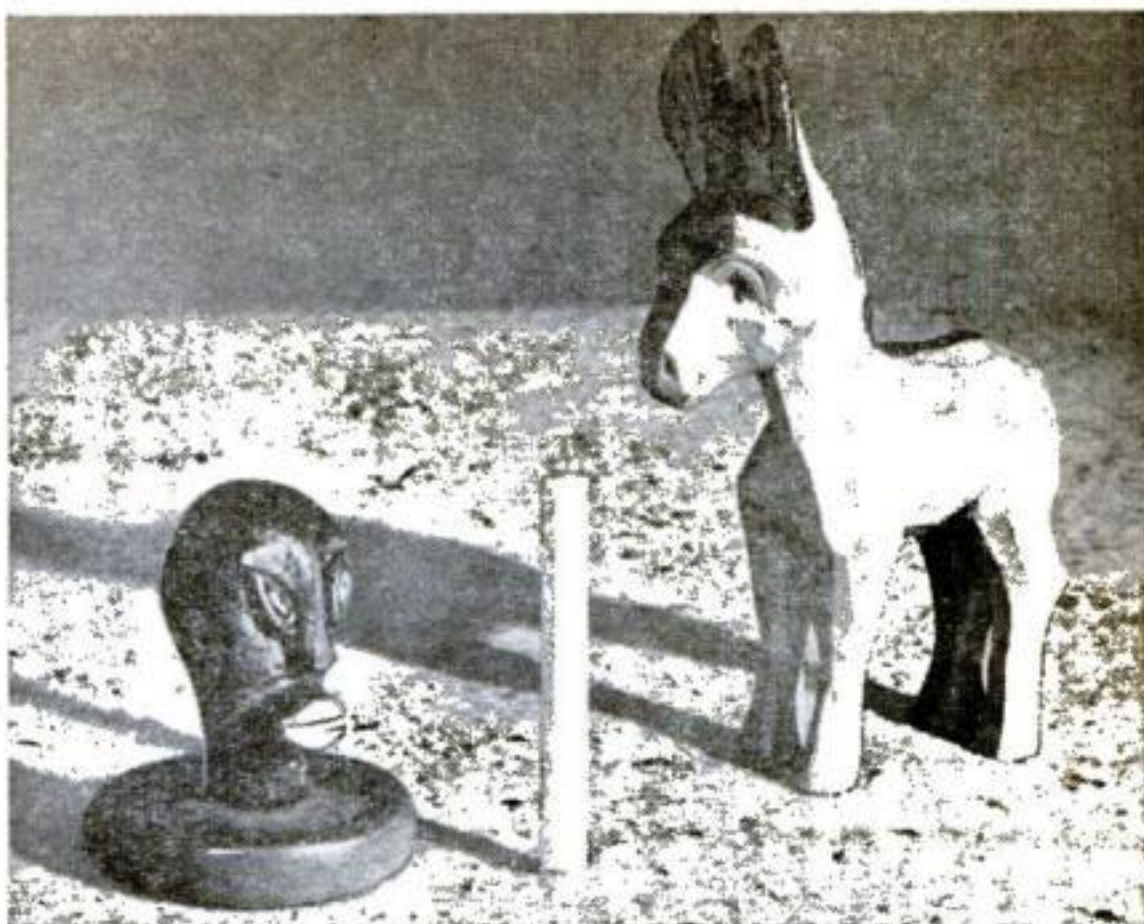
No complicated tools are required. Whelan uses a lathe to turn the preliminary rough cuts on a head, and then finishes with knives. In addition to two pocketknives, he employs a special, extra-sharp knife ground from a file, which holds its cutting edge longer than most tools. A small auger held in a pin vise provides special effects like the grooves around the eyes of the heads, and a coping saw cuts the flat surfaces on the

Whelan uses a lathe to turn the rough outlines of his figures; then he finishes the work with knives. Final touches are applied with a tool he made himself, a razor-sharp knife that was ground from a file.





A coping saw cuts the flat surfaces on the miniature animals. The cigarette is shown for size comparison.



little dogs, donkeys, and other animals.

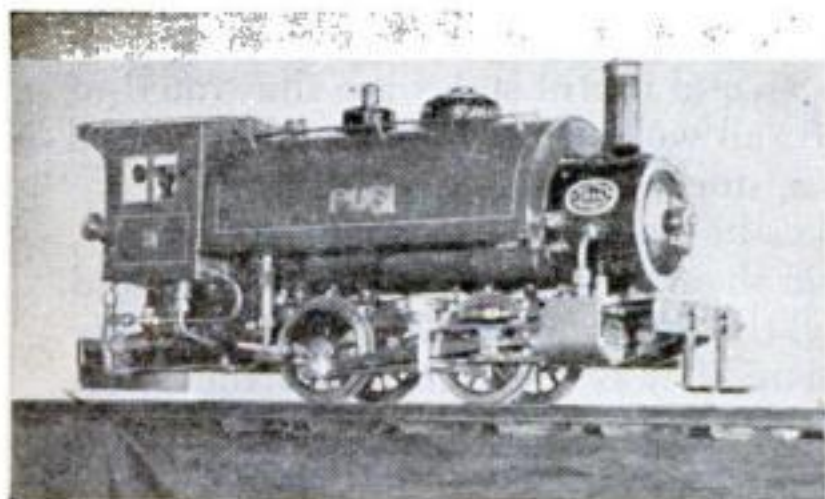
Almost any type of wood furnishes the raw material for the small figures. Whelan has carved mahogany, redwood, soft pine, desert mesquite, and ironwood. For finish-

ing, paint and varnish are used. The time required to produce a head varies with the size and intricacy; a lapel pin can be made in three hours, while one of the large heads might take 25.

Scale-Model Steam Engines Can Pull Loads as Heavy as One Ton

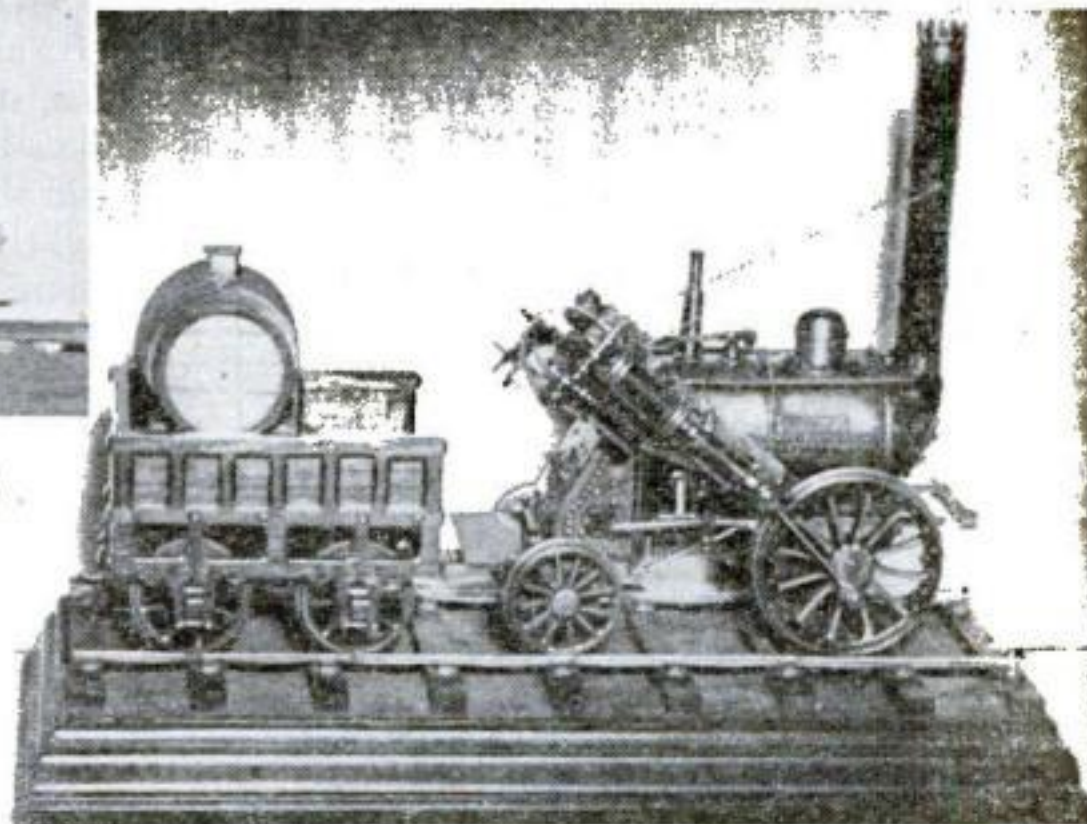
ACCURATE scale models that really work come from the basement workshop of John Matthews, Chicago plumber. Specializing in steam engines, he has built miniature replicas of a Hudson locomotive, an Atlantic passenger locomotive, and an early mine pump by James Watt, as well as the "Pug"

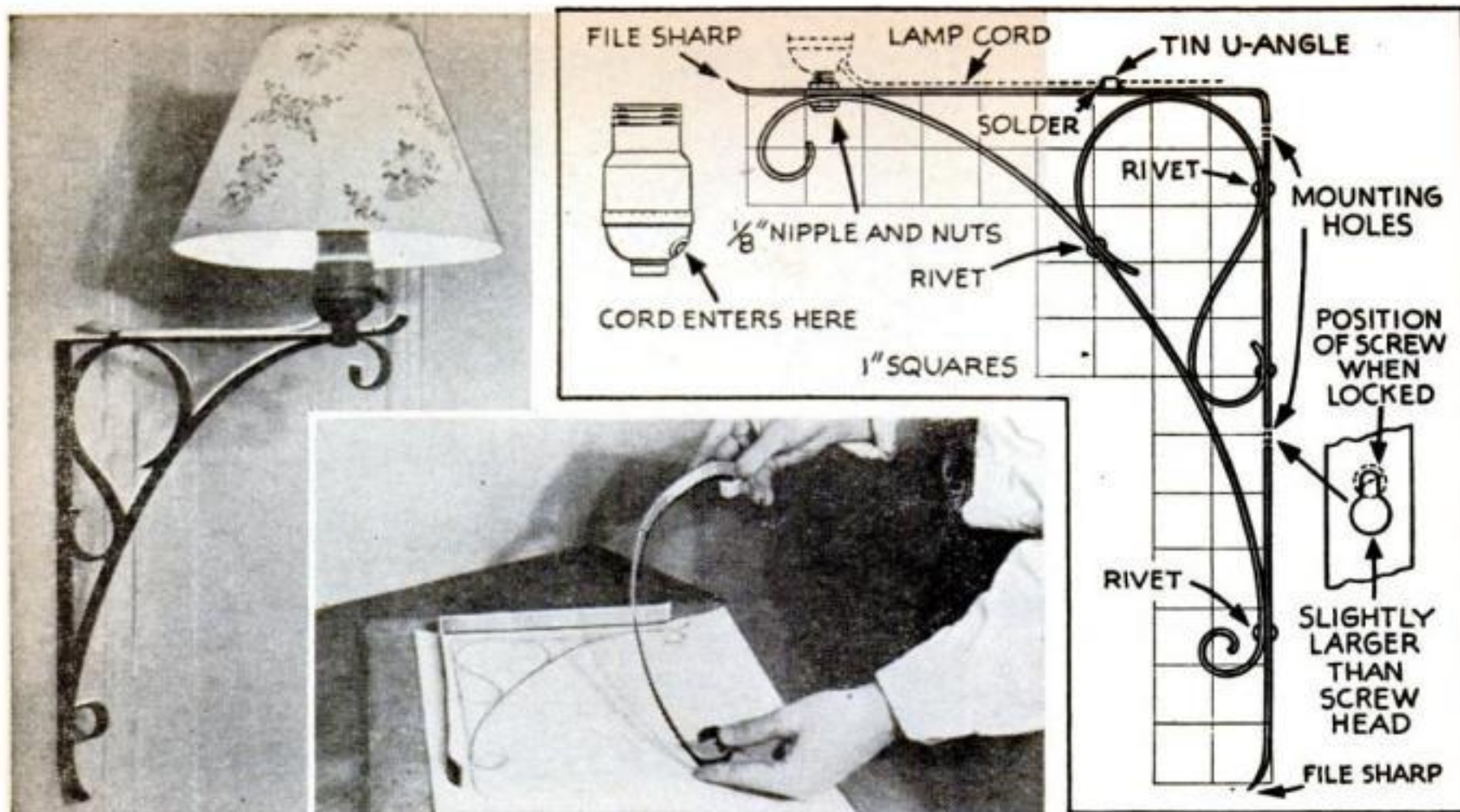
quarry engine and the Stephenson's Rocket shown in the photographs below. Matthews spent 2,000 hours making the Hudson, which is 6' long and weighs 200 lb. It can pull a one-ton load. The 4' long "Atlantic" races along its small tracks under 250-lb. boiler pressure. Matthews works from the original shop blueprints and makes all parts himself.



This "Pug" locomotive, scaled $\frac{1}{4}$ " equals 1', is a type frequently used in quarries. John Matthews made all parts for the working model himself.

In 1829 the original of the model at right was the latest thing on wheels. A reproduction of George Stephenson's first locomotive, the Rocket, it runs under its own steam.





Pin-up Lamp of Wrought Iron Will Brighten Any Dark Corner

Just the thing for a dark corner or over a favorite chair, this lamp was made of $\frac{3}{8}$ " strap iron, the S-brace being hammered around a piece of pipe and the other parts shaped over a full-size layout.

The upper ends of the two main members were bored to take a $\frac{1}{8}$ " nipple for the key

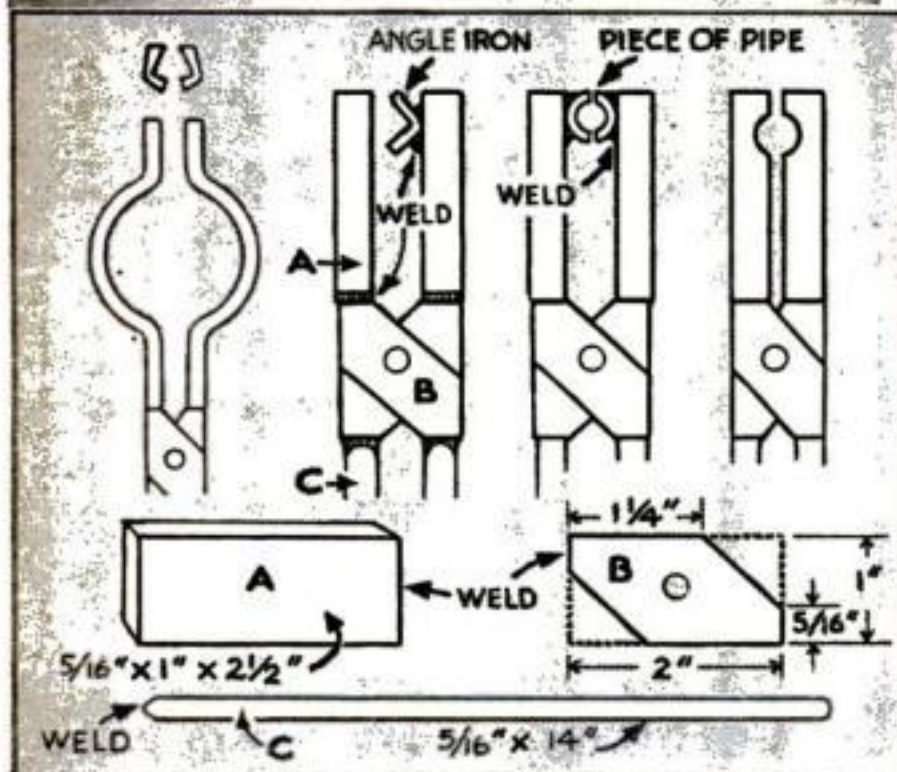
socket, and two thin nuts placed on the nipple clamp these parts of the bracket together. Mounting holes were bored large enough to slip over the heads of the screws to be used, and slots were then filed upward to accommodate the screw shanks. A coat of black finishes the project.

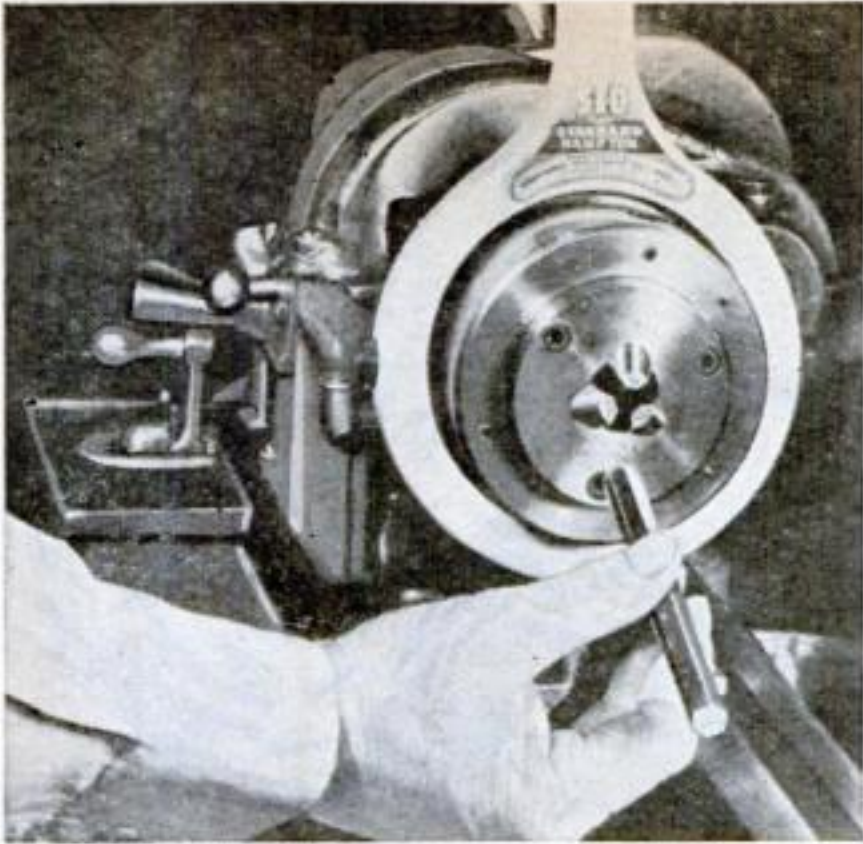


Forge Tongs Welded to Order

STANDARD forge tongs will pull most of your chestnuts out of the fire, but if your forging problem is one that requires extra safety or extra efficiency, it may be well worth your while to weld a pair of tongs with exactly the right grip for your special work. Several useful styles are illustrated at the left, all welded up from standard round and bar stock.

Make the halves of the tongs separately, and join them with a rivet. The hole should be slightly larger than the rivet for easy operation; if it is too tight, heat the tongs to a bright red and work the jaws up and down to loosen. Before welding, grind all butting edges so that they form a "V" when placed together and allow plenty of surface for the weld metal to form a sturdy joint. A piece of angle iron welded into the jaw will hold various sizes of round stock; halves of pipe are useful for a single round-stock size. The recessed semicircle in the jaw makes the tongs suitable for either round or flat stock.—JERRY POKORNY.



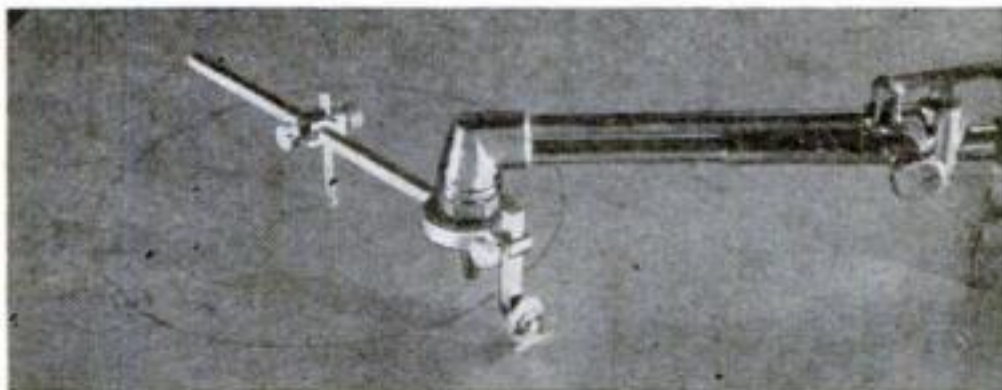


A HIGH-SPEED CHUCK designed to increase production and lower costs on short-run shop work can be opened and closed without stopping motor or spindle. The chuck is said to compensate for spindle run-out, and it adjusts for close-tolerance concentric or eccentric turning operations. Quickly installed spacer and stop accessories are available for the "Standard-Hampton Speed Chuck," says its maker, the Standard Tool and Gage Co., of Cleveland.

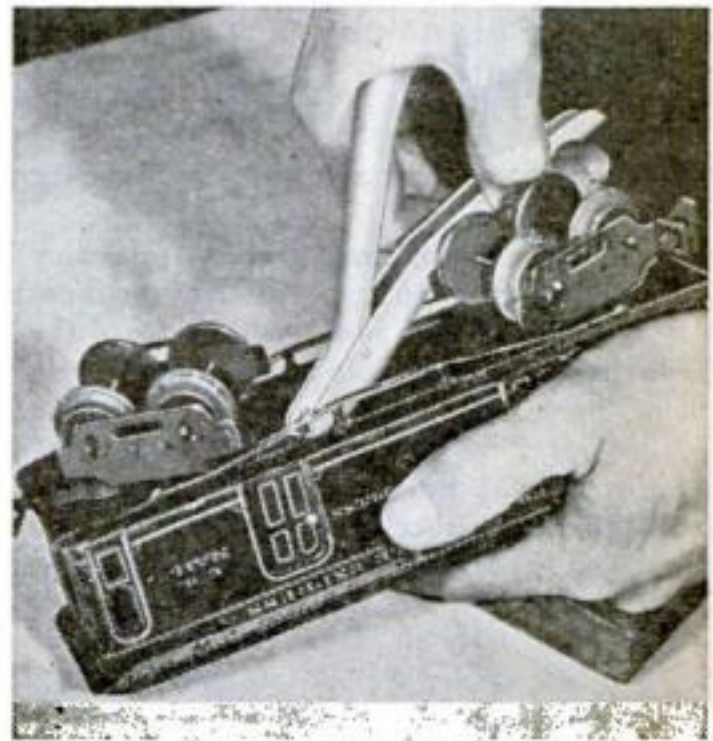
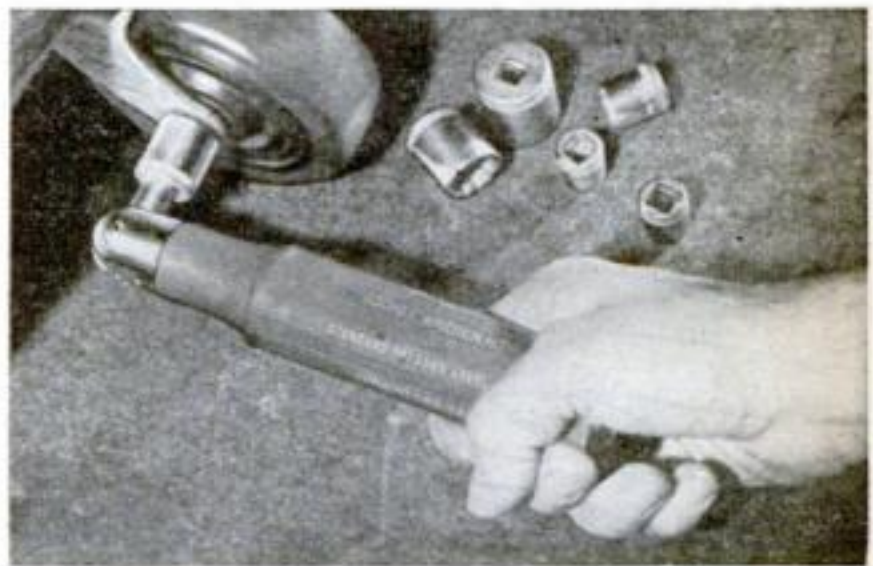


TOGGLE PLIERS that multiply a 40-lb. pressure on the handles to 400 lb. on the work have been developed to hold small parts for welding, drilling, and the like in cramped spaces. Rubber-capped pressure pads prevent depression marks on soft metal pieces. The manufacturer is Knu-Vise, Inc., of Detroit.

PERFECT CIRCLES ARE CUT from boiler plate or heavy sheet metal with the help of a new adapter for flame-cutting torches. A square radius bar swings the torch jet around on a tracking wheel. The Scientific Research Co., Portland Ore., makes it.



MULTIPURPOSE TOOLS that carry an assortment of interchangeable bits in their hollow plastic handles are being made for shop, home, and farm use. Bits adapting the different tools to socket-screw, socket-wrench, or auto work as well as general home repairs snap over a swivel mount that reaches hidden parts. Standard Pressed Steel Co., Jenkintown, Pa., is the maker.

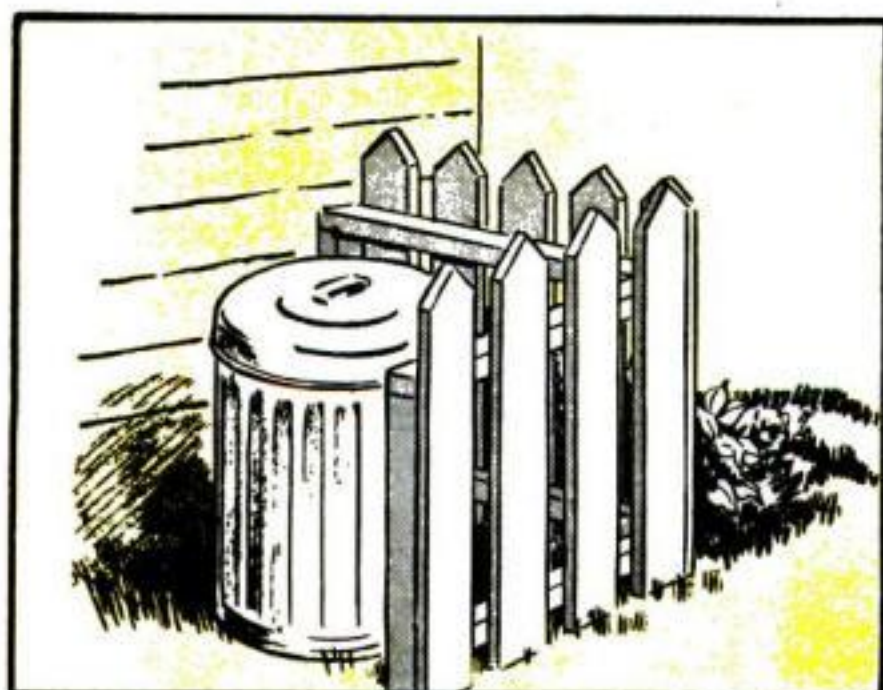
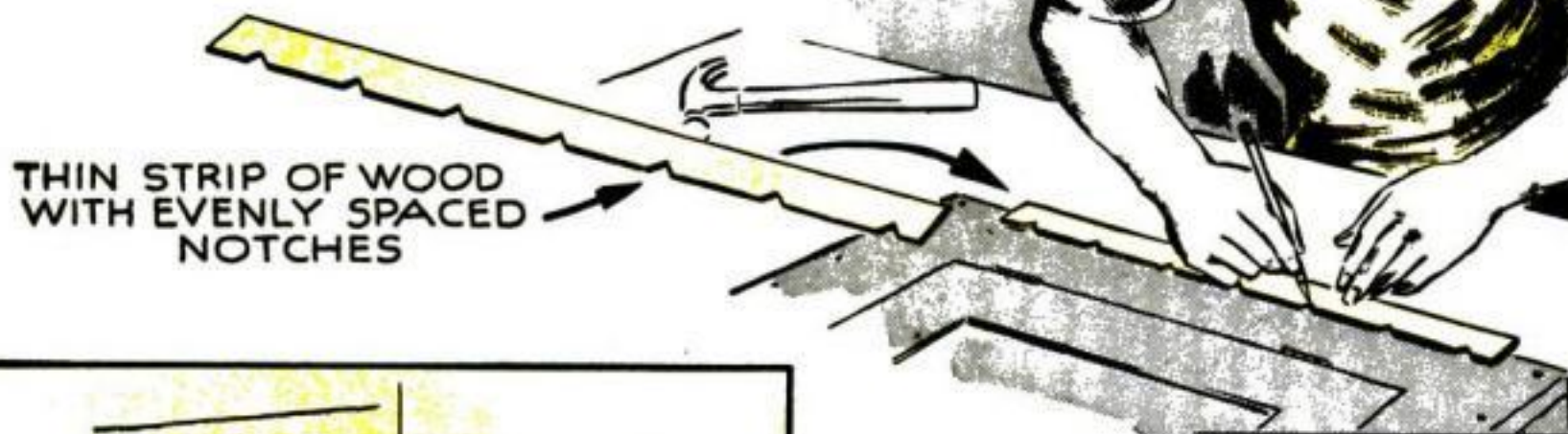


RIVETED FASTENINGS can be used on models and other small shop work easily and quickly with a new lightweight riveting gun of the type used in airplane construction. A one-hand plierlike tool that installs blind $3/32$ " rivets with a simple pull, it is made by Cherry Rivet Co., of Los Angeles.

KEEPING the HOME SHIPSHAPE

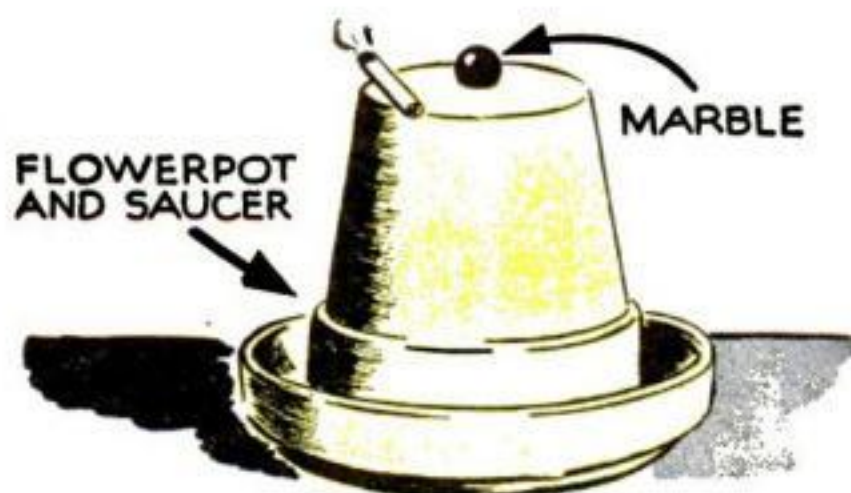


In many hammer-and-saw jobs around the house or shop, it is unnecessary to conceal nail or screw heads on the face of the work. Even such projects, however, can profit from the regular spacing of screws or nails that is the mark of good craftsmanship. A thin strip of scrap wood, notched evenly along one edge, will assure this uniform spacing.



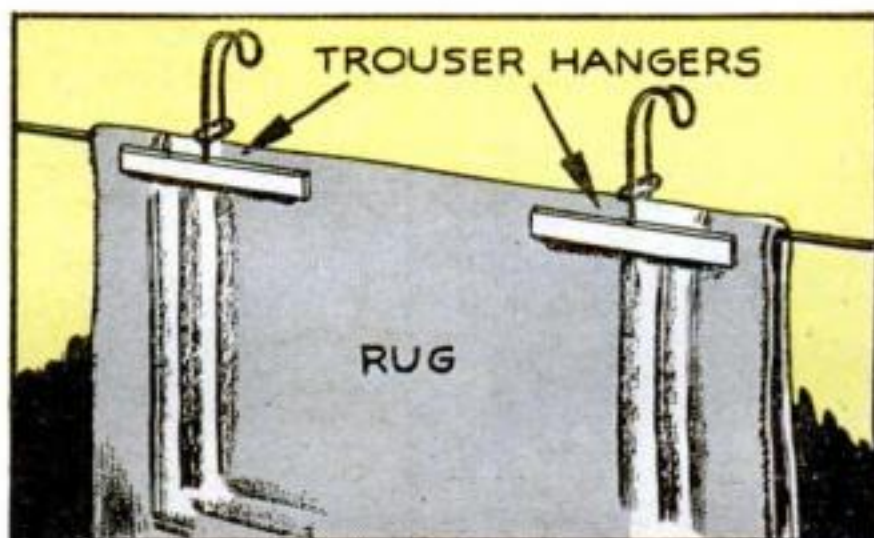
Garbage or ash cans left outside the house for collection tend to mar the appearance of a yard. A small L-shaped fence will conceal the can while leaving it accessible for filling and emptying.

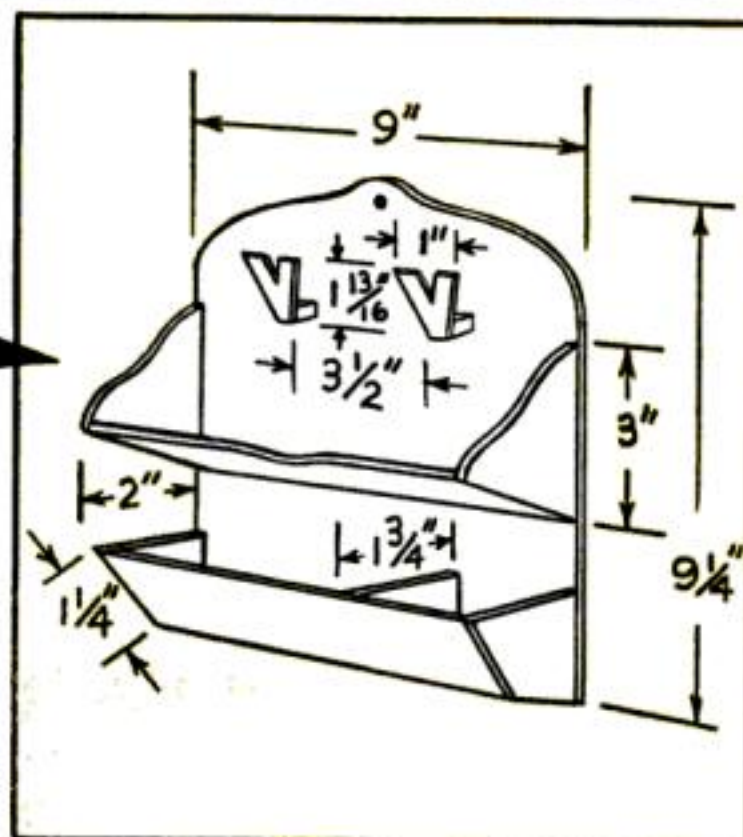
Before sweeping up a dusty workshop, pour some oil-type furniture polish into the heel of the broom. The liquid will tend to damp the sweepings and help prevent the agitated dust from rising and resettling in other parts of the workroom.



A fireproof smoking set for the workbench can be assembled from a flowerpot, saucer, and marble. Lighted stubs dropped into the pot are quickly extinguished by placing the marble over the hole.

When hanging rugs out for beating or airing, use trouser hangers in place of clothespins as shown below. The hangers can't split on the bulky fabric and they will provide a firm grip without pinching the cloth or pressing down the nap of the rug.

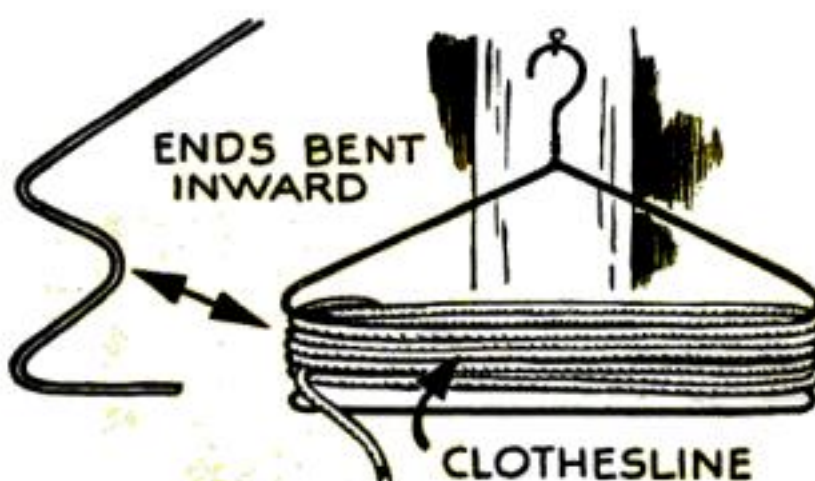




Unclutter your bathroom shelves with a hair-do rack that will have a place for a comb, brush, hair-pins, and barrettes. Make the rack of plastic or thin wood. The upper trough holds the brush, the lower is divided to separate pins and clips.



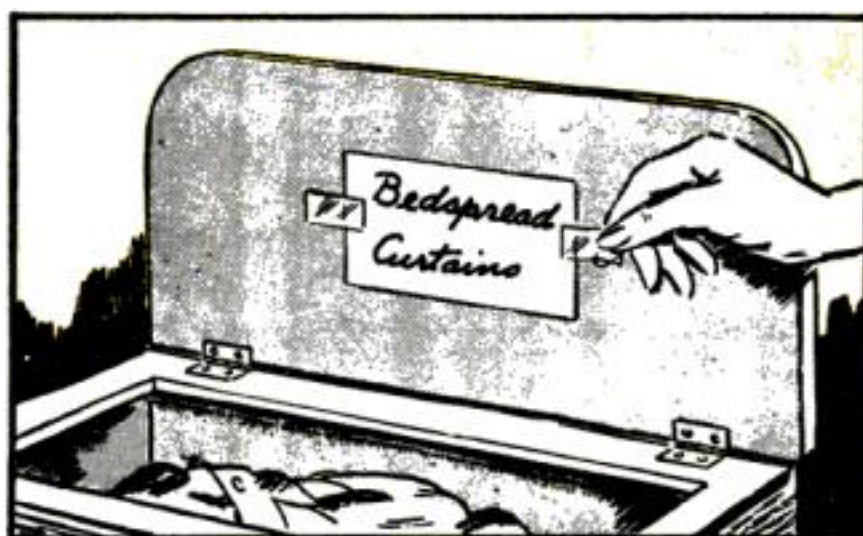
Storing your crochet hooks in a discarded toothbrush case makes it possible for you to find and select hooks at a glance; it also keeps them from getting tangled in and snagging yarn or material.



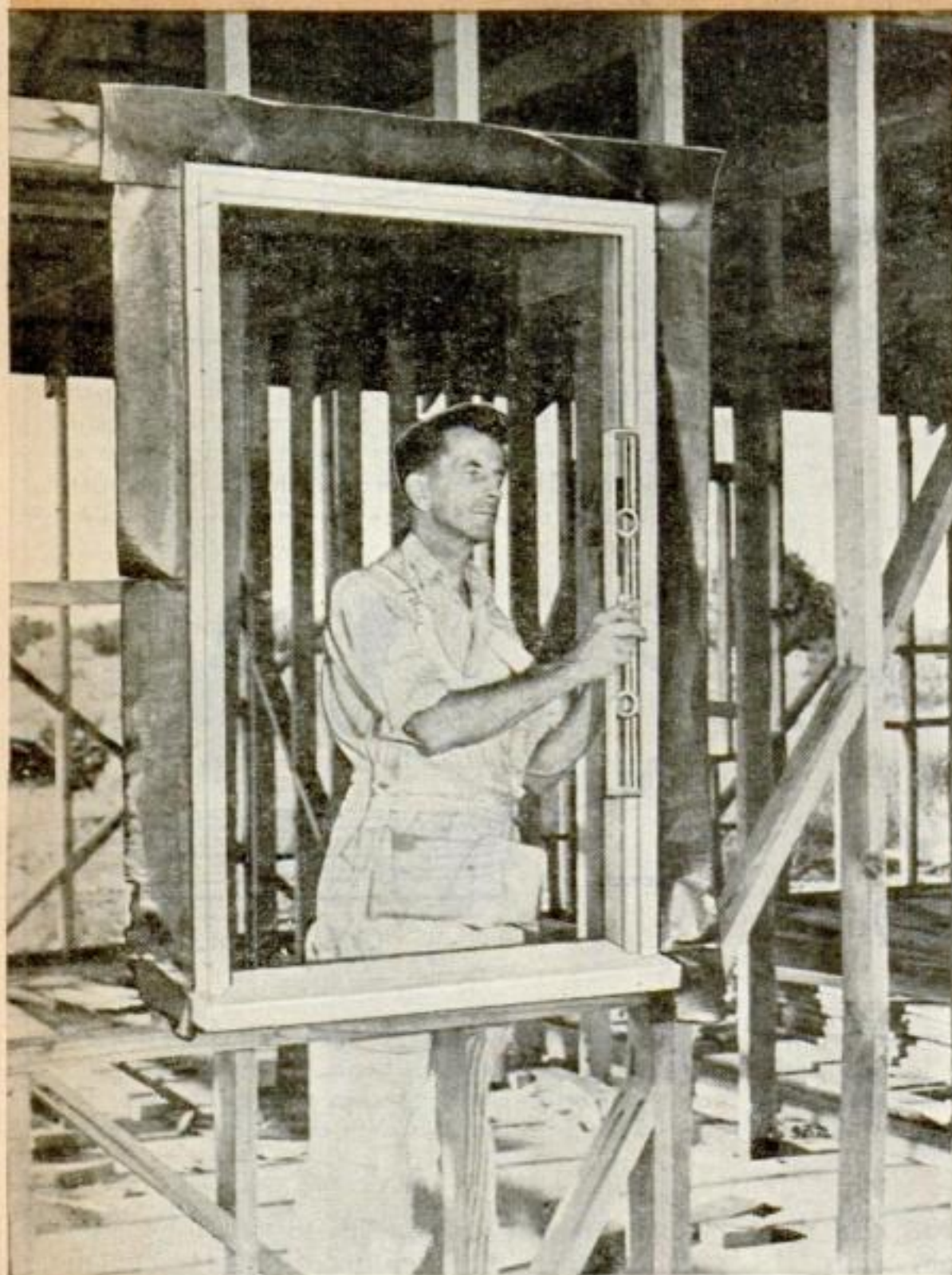
No tools are needed to make this winder for temporary clotheslines. Bend the ends of a wire coat hanger inward, as shown above, and reel the cord around it. Hang it over any convenient hook.

Most clothes hampers are too small to hold the larger articles that go into the family wash. If you are apt to forget such items when you clean out the hamper, fasten a reminder to the cover with easily removable, nonmarring cellulose tape.

Heavy garments hung outside to air will generally slide together at the center of a sagging line. To keep them properly separated, string a short section of chain between two supports, and hook the hangers through the links at fixed intervals.



Window and Door Frames for Stucco Construction



Plumbing a pulley stile in a window frame after leveling the head.

SEVENTH OF A SERIES

WINDOW frames are always set before the plastering is begun on interior walls, while door frames can be set at any time. Frames set beforehand serve as grounds, or the wood to which the plaster can be brought flush and on which the moldings are attached. They should be well oiled or primed as a protection against moisture.

The size of a frame for a double-hung window will depend, of course, on the size

By

EDWIN M. LOVE

of the sash chosen. In many parts of the country, double-hung sash is listed according to over-all dimensions, and thus the frame for a 2' 6" by 4' 0" window would be built with an opening that size.

Windows in some sections, however, are figured from stock-size glass, such as panes 26" wide and 20" or 22" high. Allowing for a 2" stile on each side, the width would thus be the same, or 2' 6", but the height would be 3' 10" or 4' 2", that is, the height of two panes, a 2" upper rail, a 3" lower rail, and an allowance of only 1" for the meeting rails since they overlap. Windows cut into four or more lights must be figured for bar thicknesses as well.

The house described in this series and shown under construction in the accompanying photos is to have a stucco finish, so the photos and drawings show the addition of stucco molding having a recess or groove into which the stucco is anchored. For another outside finish, the essential difference would be only in the outside molding or other trim. Flashing is inserted between the stucco molding and frame and nailed right in with the molding.

How the window frame is constructed is shown in Fig. 1. The width of the jamb or pulley stile must allow for double the sash

thickness, standard for which is $1\frac{3}{8}$ ", and also for $1/16$ " clearance for each sash and for a $\frac{3}{8}$ " parting bead, or a total of $3\frac{3}{8}$ ". In addition, with the blind stop nailed on, it must equal the width of the trimmer plus the thickness of plaster and sheathing. If wall-board is substituted for plaster and no sheathing is used, this width will be so narrow that there will be no room for an inside stop unless the blind stop is made thin, and even with a minimum blind stop of $\frac{3}{8}$ " it may be necessary to nail the inside trim flush with the face of the stile and lap the inside stop over its edge, as in the drawing.

Stock pulley stile comes grooved and ready to saw to length and dress to width. If it becomes sprung edgewise, straightening can only be done when the frame is nailed in the building. Because of a shortage of materials, some carpenters resort to use of clear sheathing boards for frame stock, racking it for as long as possible with cross strips between to permit air seasoning. Even then a board is likely to spring edgewise when ripped and should be left with $\frac{1}{2}$ " surplus width to allow for jointing one edge and ripping and jointing to width. Little spring results from the second ripping. The grooves

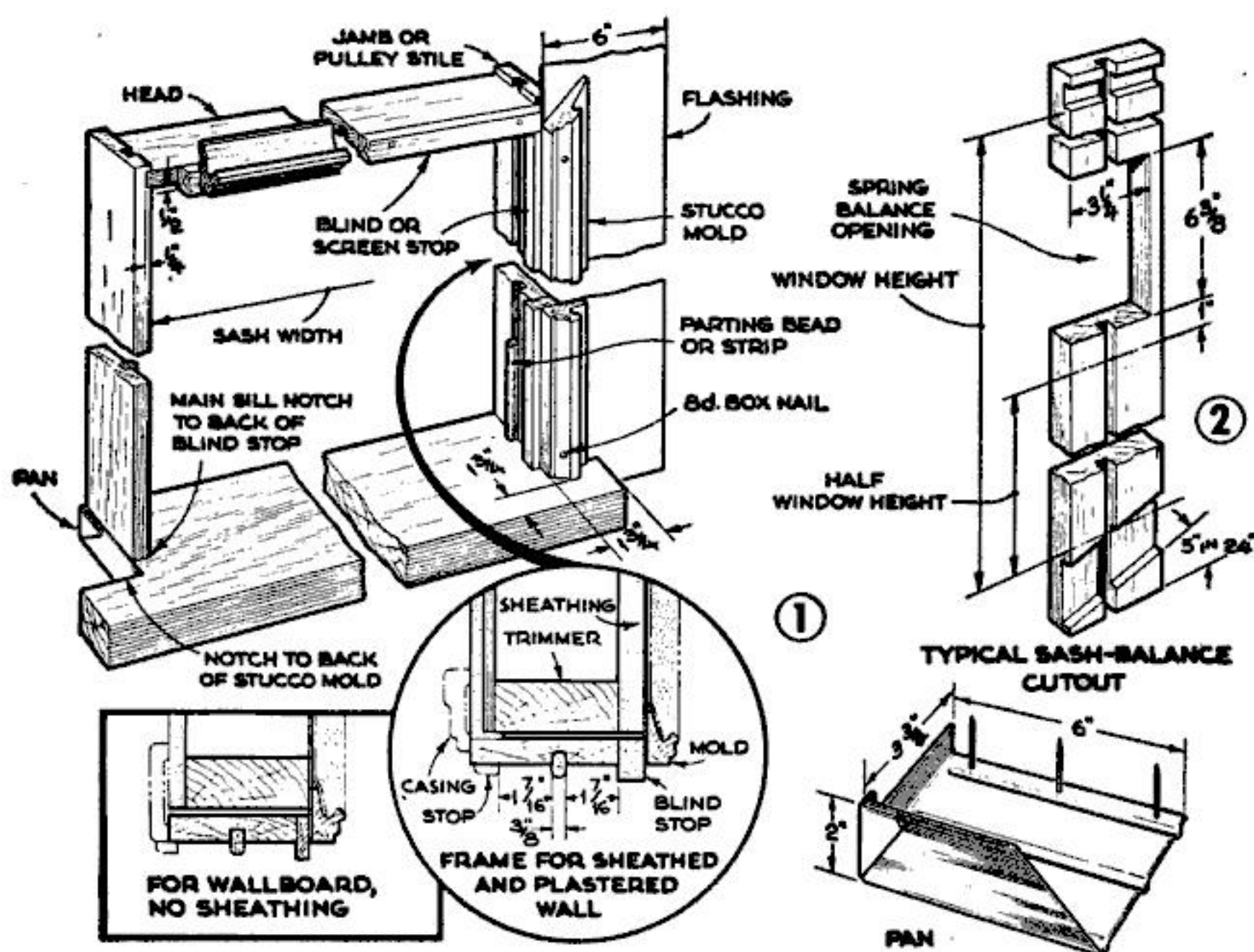
for parting beads are then plowed and the faces smoothed.

Measure window length along the inside edge of the grooves when locating the dados to take the head and sill. The dado for the head is cut square; that for the sill on an angle of 5° in $24"$ or a slope taken from the sill bevel.

Spring balances are often used instead of weights and pulleys. They permit the frame to sit snugly between the trimmers, and narrow casing is easily applied. Figure 2 shows the cutout for a typical spring balance. Bore corner holes; then rip first with a compass saw and finish by crosscutting the ends; or cut the waste out on a power saw. Handle the stile carefully to avoid breaking the slender strip left.

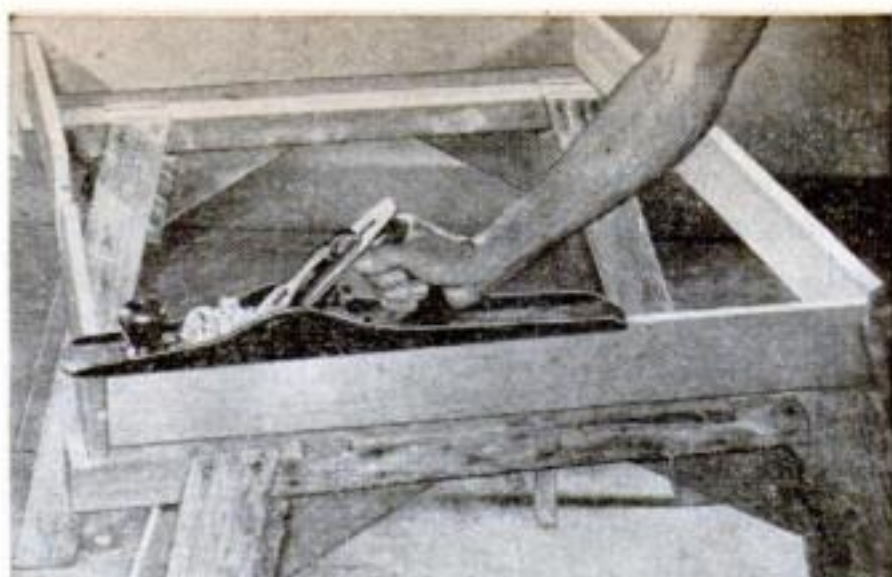
An extra $\frac{1}{2}$ " must be added to the head for housing in the pulley-stile dados, and the same allowance is made when notching the sill. The "horns" of the sill are also notched flush with the front of the blind stops to clear the trimmers. Sometimes $\frac{1}{8}$ " extra width is allowed in the frame to reduce planing of the sash in fitting.

Never paint the faces of pulley stiles. Oil them instead, or coat them with hot paraffin,



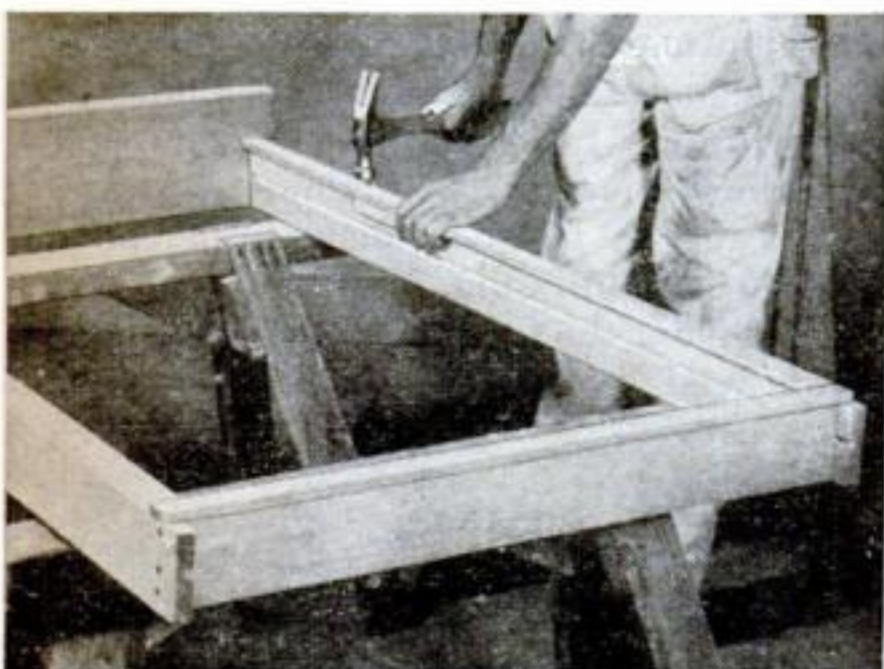


Dadoes for housing the sills in pulley stiles are cut on a slope that can usually be taken from the sill bevel, or an angle of 5" in 24" can be used.

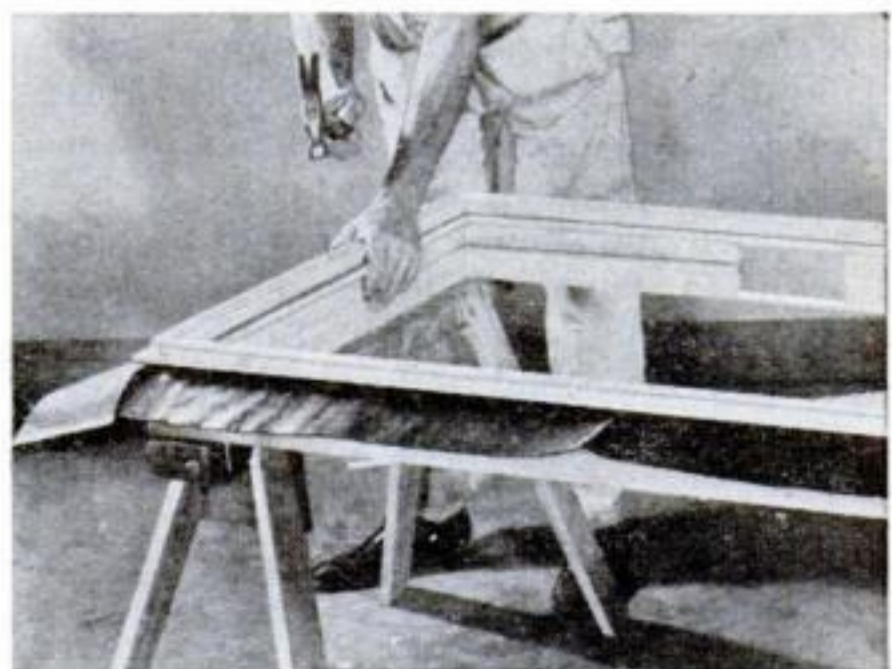


When assembling the window-frame head and pulley stiles, take care to get the parting-bead grooves aligned; then dress down projecting edges.

Blind stops are best nailed on while holding a $\frac{1}{2}$ " block against the stile face to gauge projection.



Nailing stucco molding to a gauged line. Flashing is inserted under the molding and nailed with it.



and scrape off any surplus. It is good practice to paint the joints before assembly, and after the frame has been built paint the backs, sill, and stucco molding.

Use 8d. box nails for nailing in the sill and head. If a dado is loose, drive a chisel in the joint at the outer side to take up the looseness before nailing. Square the frame by equalizing corner-to-corner measurements, nailing diagonal strips across the inside edges to hold the frame true. Nail the head blind stop in place and fit the side blind stops between it and the sill. Gauge the projection of the stops with a $\frac{1}{2}$ " block, as in the photo at lower left above.

For correctly setting a window frame, a prop equal in length to the height of the header above the floor will be needed at one corner. Start a nail in the side stucco molding next to the prop near the top, swing the frame approximately level, and tack. Level the sill and tack the opposite molding. Plumb the pulley stile and nail the mold-

ings solidly; then drive nails through the stiles. Wedge with shingles to straighten the face of a stile.

Frames for outside doors can be made from 1" stock with jamb width equal to that of the window pulley stiles. Inside frames require jambs equal in width to the trimmer plus the thickness of the plaster or wallboard on both sides. The length of the jambs from the head to the bottom is simply the length of the door plus an extra $\frac{1}{2}$ " for clearance. Assemble the door frames on the floor, nailing the joints.

To set an inside-door frame (Fig. 3), stand it in the rough opening and slide a shingle point first from each side behind one jamb. If there is to be a finish floor, place a block the thickness of the floor under the lower end. Tack fast through the shingles while holding a block against the trimmer to gauge the projection for plaster or wallboard.

Tack the upper end of the opposite jamb in the same way. Then wedge out and nail

the lower end of the first jamb, plumbing the face with level and straightedge to align top and bottom, and plumbing the edge with the level alone. If the wall is too out of plumb, it may be necessary to have the jamb lean with it in order to align them at the top and bottom.

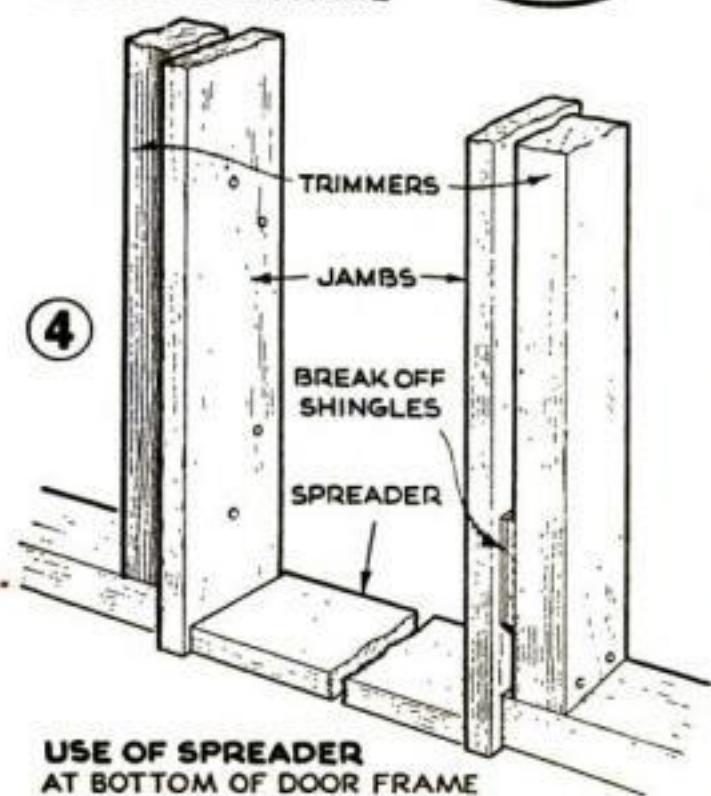
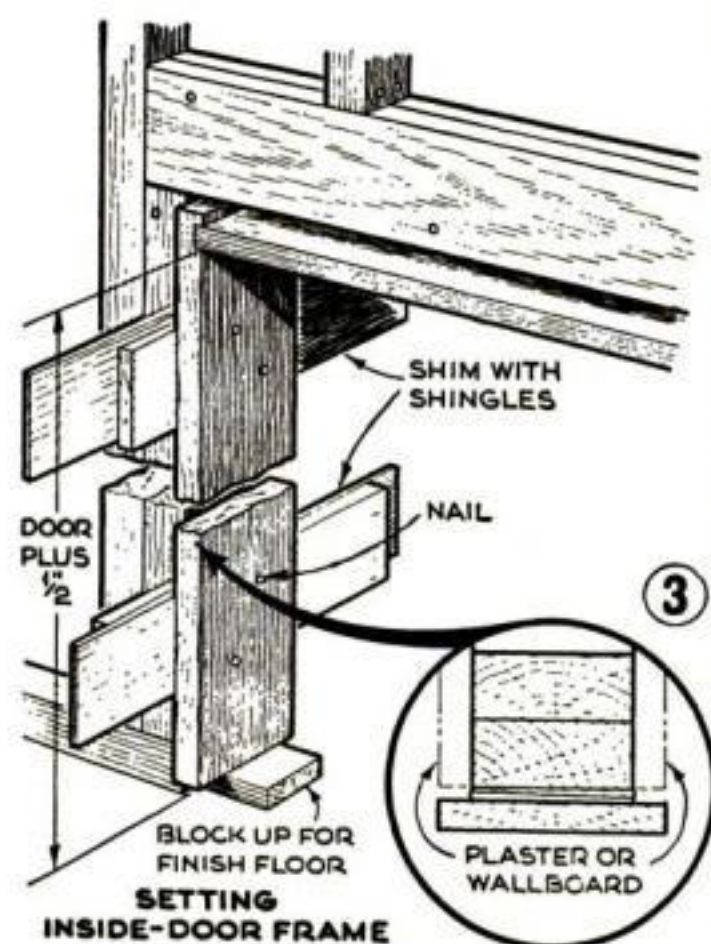
Cut a spreader gauge to lie on the floor between the lower ends of the jambs, as in Fig. 4, and nail the second jamb. Place shims behind the hinge and lock positions and wherever needed for straightening out concave bends in the face.


If the molding and flashing are left off outside-door frames until after they have been set, the open edges will make it easy to wedge jambs for straightening, as in the photo below, but some carpenters prefer to nail them in when assembling as for windows. Usually it also saves time to cut hinge

mortises in a jamb when it can be handled on the bench before assembly.

Stucco molding used at the head of a door frame and on window-frame heads is usually not in alignment, but the difference will not be noticed if the door is not close to a window. The molding is somewhat higher on a door frame since it must be $\frac{1}{4}$ " to $\frac{5}{16}$ " up from the face of the door head to show a margin, while that on the window heads is set flush with the face.

One method that simplifies the installation of a door frame in a large opening, such as that for a garage door, is to nail up the head first after leveling it from end to end. Then the jambs are straightened with shingles, as shown below, and nailed in with the upper ends fitted against the head. Flashing and stucco molding or other trim are finally added to complete the installation.





Enduring strength and gleaming beauty
distinguish things fashioned of the
steel that's king of metals.

YOU CAN MAKE IT OF

STAINLESS

By **WALTER E. BURTON**

FABULOUS metals, once undreamed of in the average home workshop, can be yours for little more than some junkyard prospecting. Stainless steels are among the most fascinating of the alloys developed in recent years. Many types can be found at hardware stores and in scrap-metal yards as war surplus, or may be obtained from regular steel distributors.

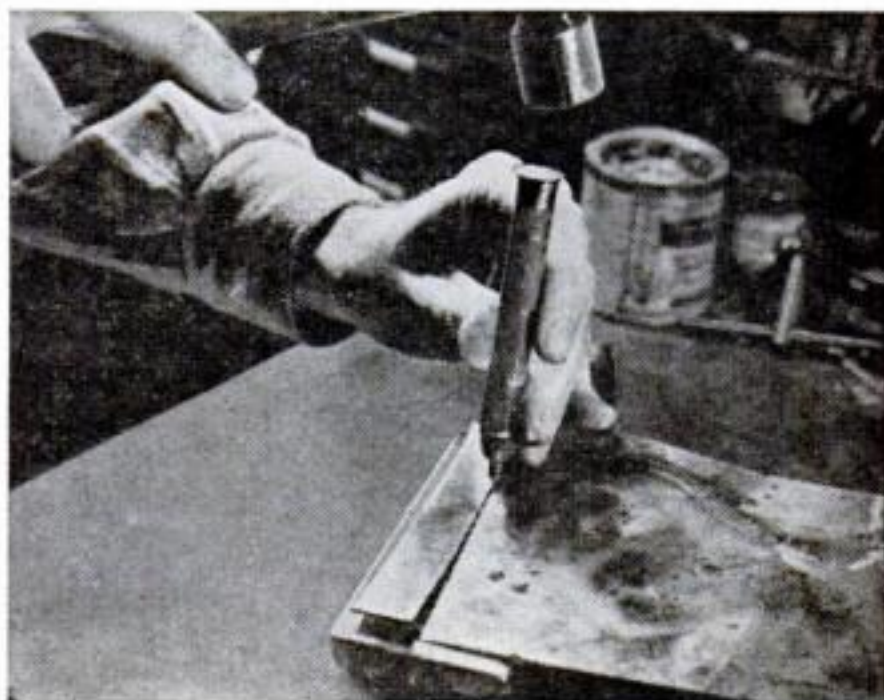
With stainless steel you can make a variety of things for the home, shop, darkroom, laboratory, or wherever its enduring brightness and resistance to rust and corrosion are desirable. You can make covers for photo developing tanks, trays for print-processing solutions, special film racks, and movie-film reels. Numerous kinds of kitchen knives, forks, and other utensils can be fashioned from the alloy. It can be made into tweezers of all sorts, tools for modeling clay, and trowels for handling molding sand, plaster of Paris, concrete, and the like.

Also possible are rings, earrings, brooches, fittings for boats, thin-sheet monograms for automobile doors, handbags, and the like, and dials for gauges and other instruments. Shown on these pages are sugar tongs, a spatula, a darkroom stirrer and print lifter, and a pancake turner—all made from stainless gathered in an afternoon of exploring at a neighborhood junk dealer's.

In searching for stainless steel, probably your first clue will be the absence of rust. If the piece is covered with grease and dirt, rub a spot clear with waste or a stick, and if the metal shows bright, the chances are it's what you want (unless it is obviously too light, in which case it may be aluminum or magnesium alloy). A sure test to tell stainless from other steels is immersion in a strong copper sulphate solution after the surface has been cleaned bright and free of grease. If it is stainless, no red copper deposit will form.

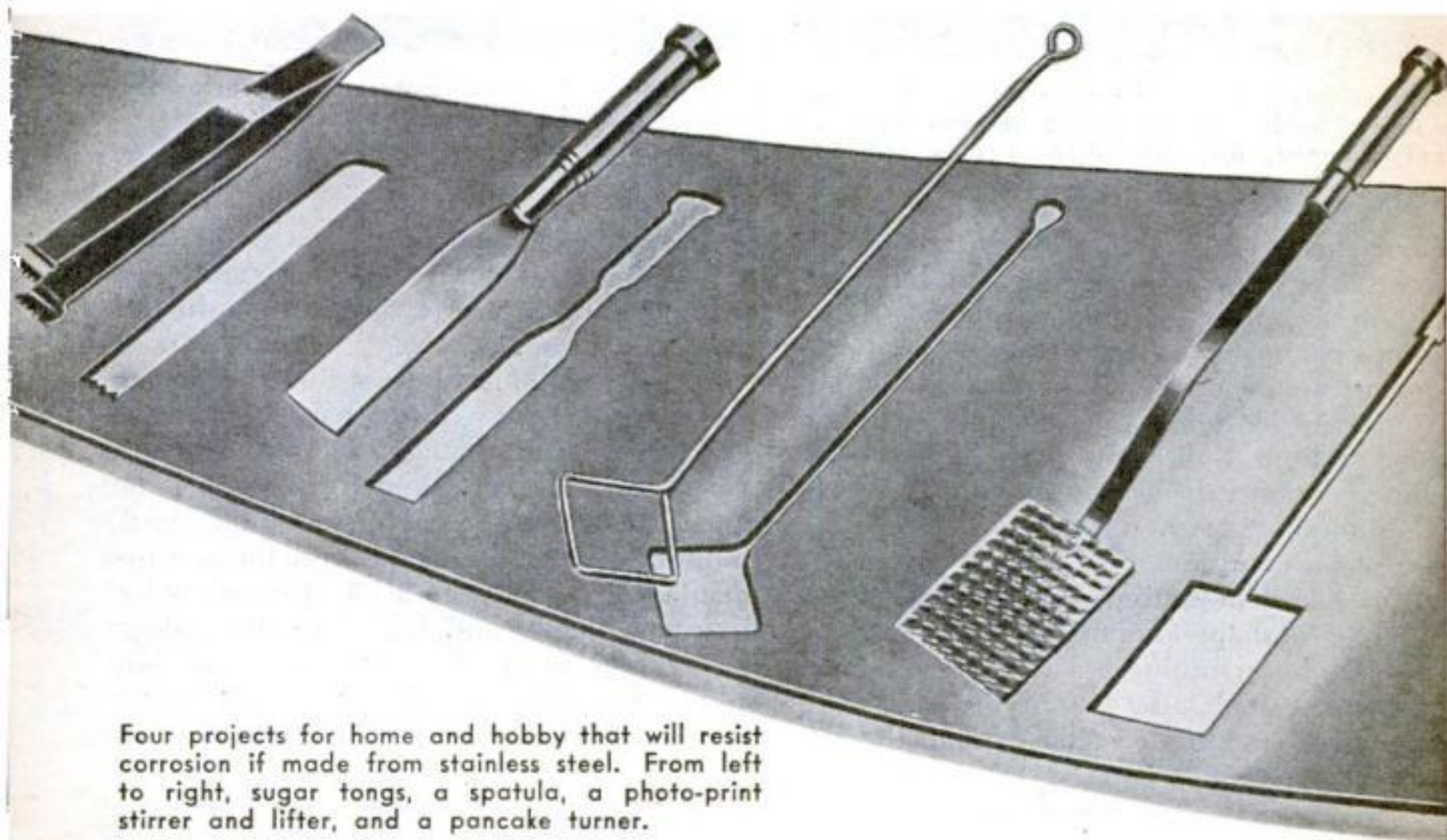
There are magnet and heat tests, too,

Stainless sheet laid on an iron or steel plate can be cut with a chisel. It's best to cut almost through and finish by bending until the cut breaks.



that will identify the type of stainless steel, as described in the data sheet on page 176. These are important when the steel is to be used for making certain projects. Group A, for instance, contains the only stainless that can be hardened by heat treatment for a really good knife blade that will keep an edge, while a developing tray or other object that requires maximum resistance to corrosion is best made from a steel in Group C. This group contains the well-known 18-8 alloy (18 percent chromium and 8 percent nickel) and is the only group that is nonmagnetic.

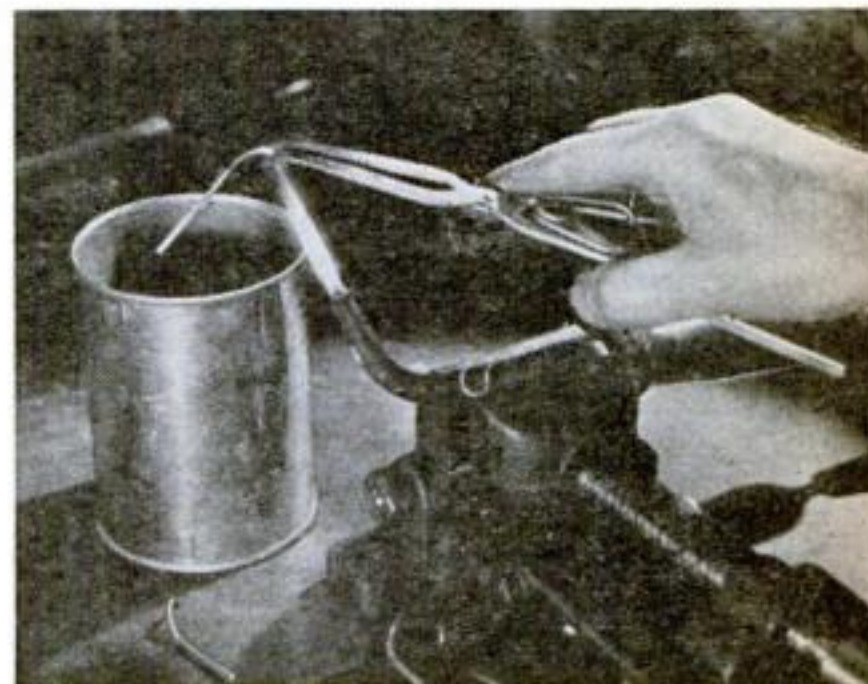
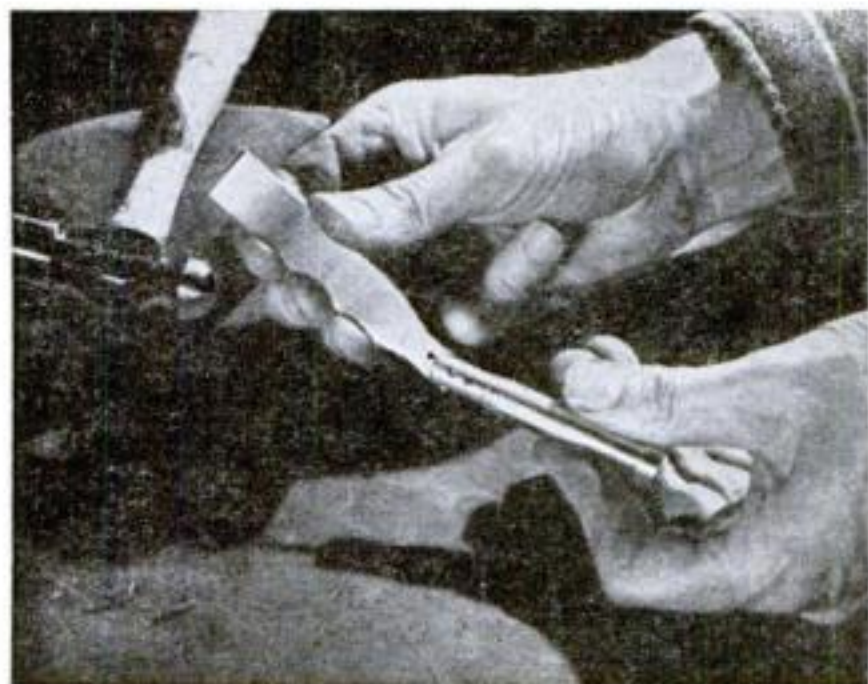
Despite its hardness, stainless steel can be worked readily with proper tools. Drills and cutting tools should be of high-speed steel and should be sharp. They must be fed into the work at a slower speed than that for cold-rolled steel and with constant pressure, for even the slightest relaxation may cause the alloy to glaze over and resist further cutting. Punch marks should be shallow, as the steel has a tendency to work-harden. Since Group B and Group C stainless steel may already be work-hardened before you get them, annealing by heating yellow-hot and plunging in water may save

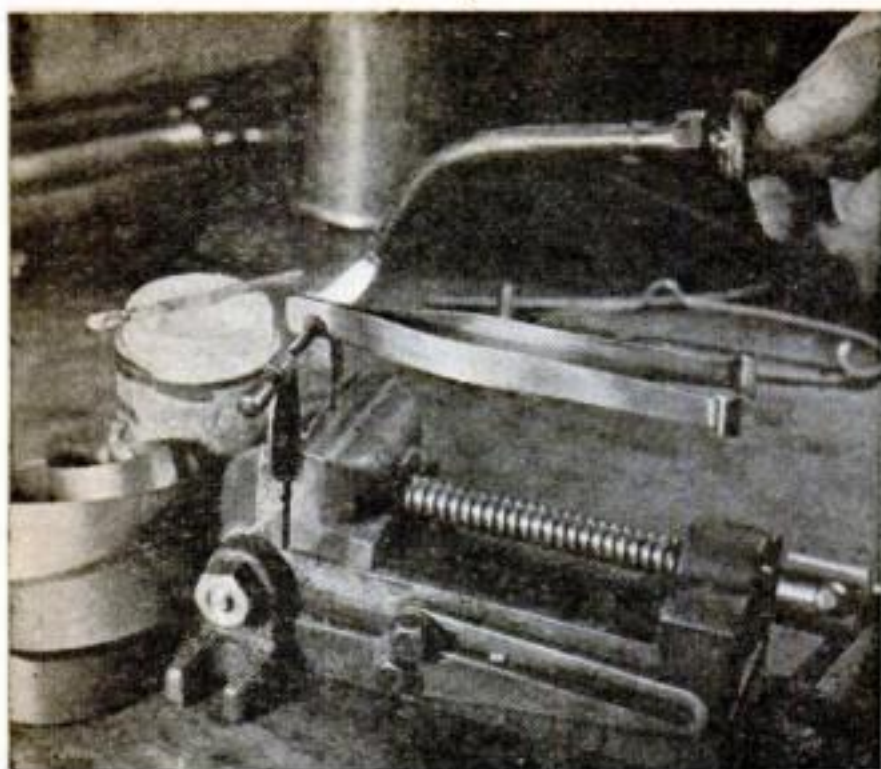


Four projects for home and hobby that will resist corrosion if made from stainless steel. From left to right, sugar tongs, a spatula, a photo-print stirrer and lifter, and a pancake turner.

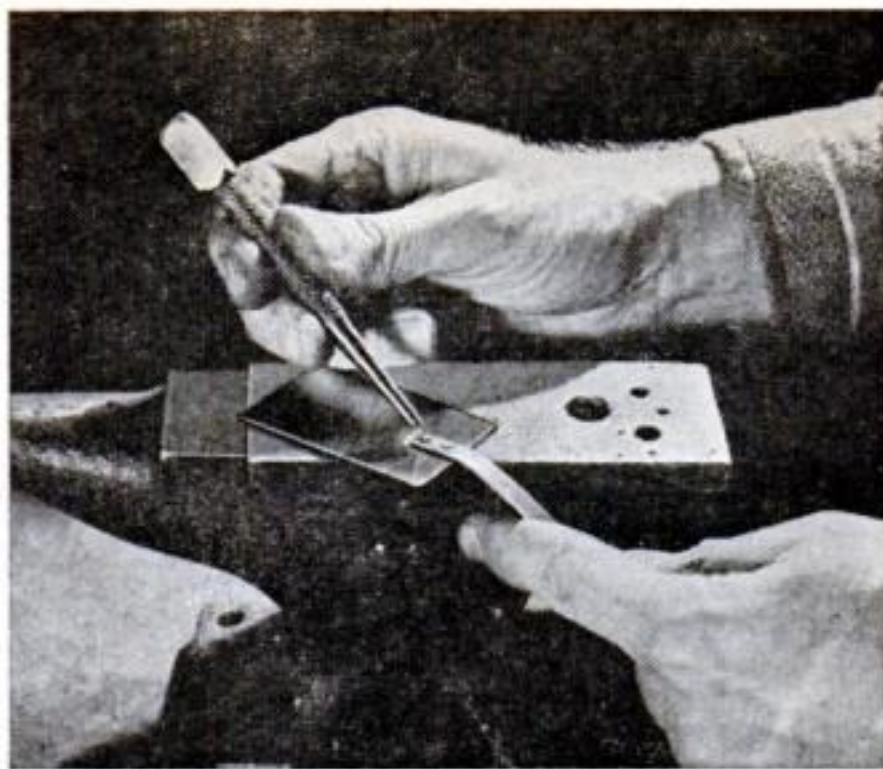
Inserting a stainless spatula blade in a handle made from an aluminum bolt. Stainless rivets cut from wire are shown on the bench at lower left.

Stainless-steel wire can be annealed for easier working by heating yellow hot and plunging into water, just opposite to method for common steels.





Silver-soldering a set of kitchen tongs. Flux and a shim of solder are sandwiched between the steel and clamped, and the torch is then applied.



Short lengths of stainless-steel wire are riveted by peening the ends with a coarse nail set. Here the handle is riveted to a pancake turner.

time. This procedure is, of course, the exact opposite to ordinary steel annealing methods and, as it implies, the stainless steels in these groups cannot be heat-hardened.

Thin stock can usually be drilled without a lubricant if backed by a block of ordinary steel or iron. Lubricants used include sulphurized mineral oils and sulphurized lard oil, sometimes with turpentine added, and also water emulsions.

An excellent chisel for cutting sheet roughly to shape preliminary to filing can be made by mounting a $\frac{1}{4}$ " round or square high-speed-steel lathe bit in the end of a piece of $\frac{1}{2}$ " cold-rolled stock. Grind the bit

to a chisel edge that is not too blunt. Cut part way through the sheet and finish by bending the metal back and forth until the cut breaks through.

All of the stainless steels may be joined with soft solder or with the harder soldering alloys melting at about 1,175 deg. F. They may also be silver-soldered to copper or other steels. When silver-soldering, coat both surfaces to be joined with the recommended flux, sandwich a bit of sheet solder between, clamp, and heat until the solder flows; then wash off excess flux with hot water. Stainless-steel rivets can be made by annealing and cutting Group C wire.

PROPERTIES OF STAINLESS STEEL

[METAL WORKING]

Metallurgists classify stainless or chromium steel in the following three groups:

Group A (martensitic), containing less than 0.4 percent carbon, less than 16 percent chromium. Tungsten, nickel, silicon, columbium, aluminum, and molybdenum may also be present. The steel is magnetic.

Group B (ferritic), containing low carbon percentage, more than 16 percent chromium. Copper, nickel, silicon, molybdenum, tungsten, and nitrogen may also be present in small quantities. The steel is magnetic.

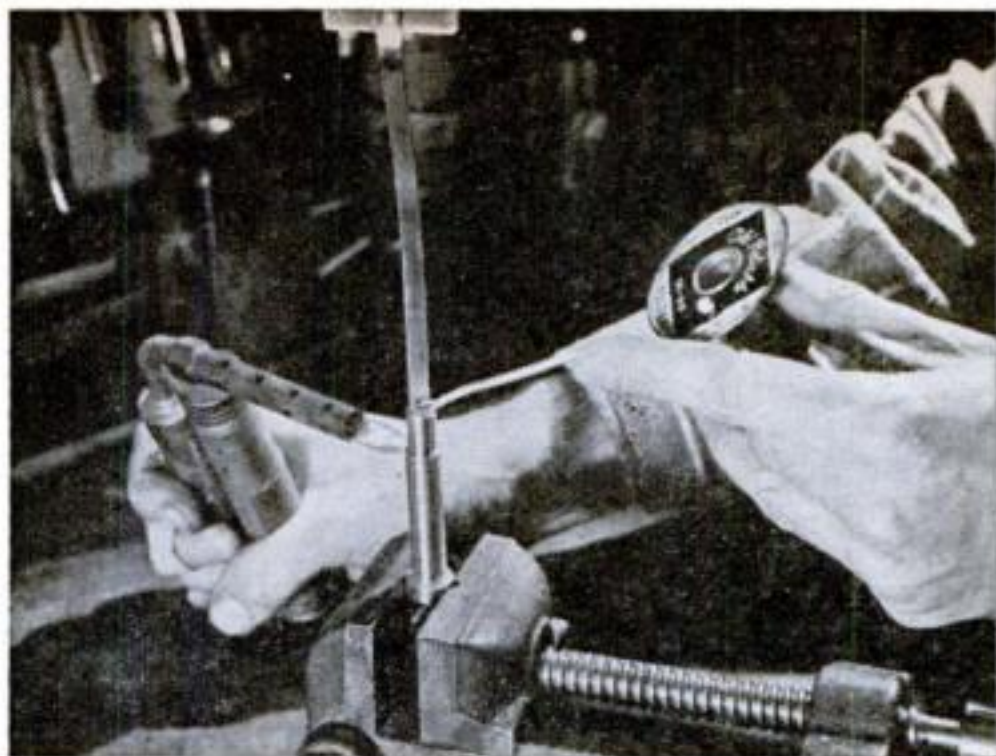
Group C (austenitic), containing at least 24 percent alloy, including sufficient nickel to make the steel austenitic and either twice as much or half as much chromium as nickel. Low carbon. The steel is nonmagnetic.

By cross-checking with two tests, a sample can usually be identified. If it is attracted by a magnet, it is in Group A or Group B; if not, it is in Group C. When heated yellow-hot (about 1,800 deg. F.) and quenched in water, it is in Group A if it hardens like tool steel, in Group B or Group C if it does not harden.

Steels in Group A are tough, not brittle, after heat treatment, are readily forged, pierced, or rolled at 2,000 to 1,700 deg. F., and can be machined satisfactorily with properly designed tools. Those in Group B are sufficiently tough when properly rolled and heated; they may be forged, rolled, or pierced when heated quickly, and can be machined with properly designed tools. The Group C steels are extremely tough. They may be forged, rolled, or pierced, but are difficult to machine even with super-high-speed and carbon tools. Use sharp tools, with greater top rake than usual, and cut continuously.

Group A resists corrosion by weather, water, steam, and mild corrosives; Group B resists also nitric and other oxidizing agents; Group C resists nearly all corrosives and is especially resistant to organic acids.

POPULAR SCIENCE MONTHLY SHOP DATA



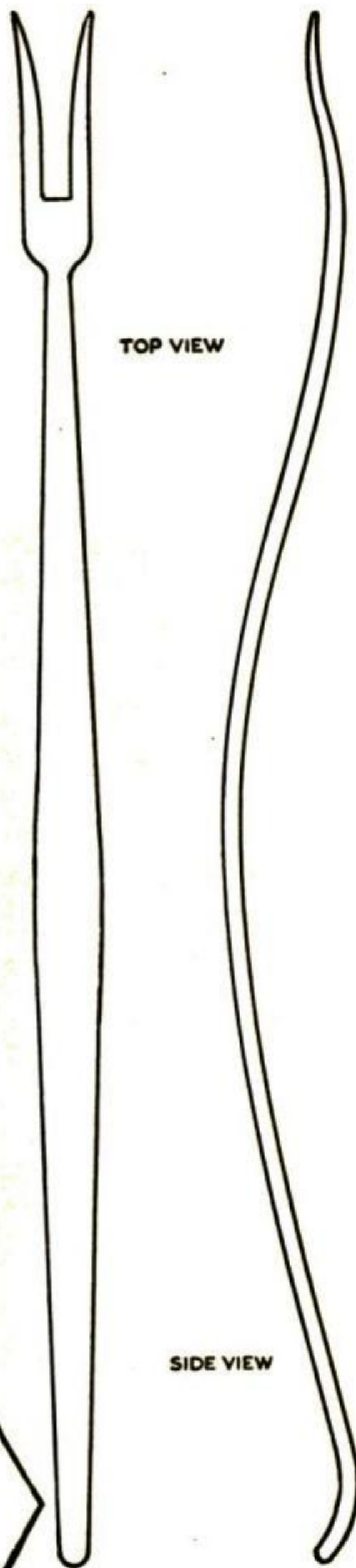
When a flat shank is driven into a round hole, the spaces around it can be filled with solder. Drill holes in the shank first; solder, flowing in, will anchor it.

While the chemical composition of stainless steels makes them resistant to corrosion, a fine polish will increase this resistance; but use aluminum buffing compounds, not iron compounds (rouge), embedded particles of which may later rust. Before polishing, it is advisable to place the finished piece in a solution of equal parts of concentrated nitric acid and water for about an hour and a half, taking care to keep the acid off the skin and clothing. This dissolves bits of the tool embedded in the surface.

The tongs shown were made from $1/32''$ springy 18-8 stainless bent cold so the jaws stand 1" apart. Similar ones may be of one-piece construction, or identical halves may be riveted or silver-soldered. The spatula, of the same steel, was made with a short tang and riveted in a slot in an aluminum-bolt handle that had been machined to remove the threads. Annealed first for easier bending, $3/32''$ Group C wire was shaped into the stirrer-lifter. The pancake-turner blade was spot-polished $.020''$ by $1\frac{1}{2}''$ by $2\frac{5}{16}''$ stainless, the shank $.050''$ by $\frac{1}{4}''$ by $6\frac{1}{4}''$ stainless, and the handle a $7/16''$ by $2\frac{1}{2}''$ aluminum-alloy aircraft bolt.

FORKS OF STAINLESS STEEL won't be discolored by foods. This one, made of $3/32''$ sheet, is for serving olives and pickles. The prongs are cut with a hacksaw and lubricant, and the shape is then roughed out on a grinding wheel and filed smooth. Contours are bent between soft jaws in a vise.

Polish with several grades of emery cloth from coarse to fine, and finish with aluminum buffing compound.—WILLIAM GORDON.

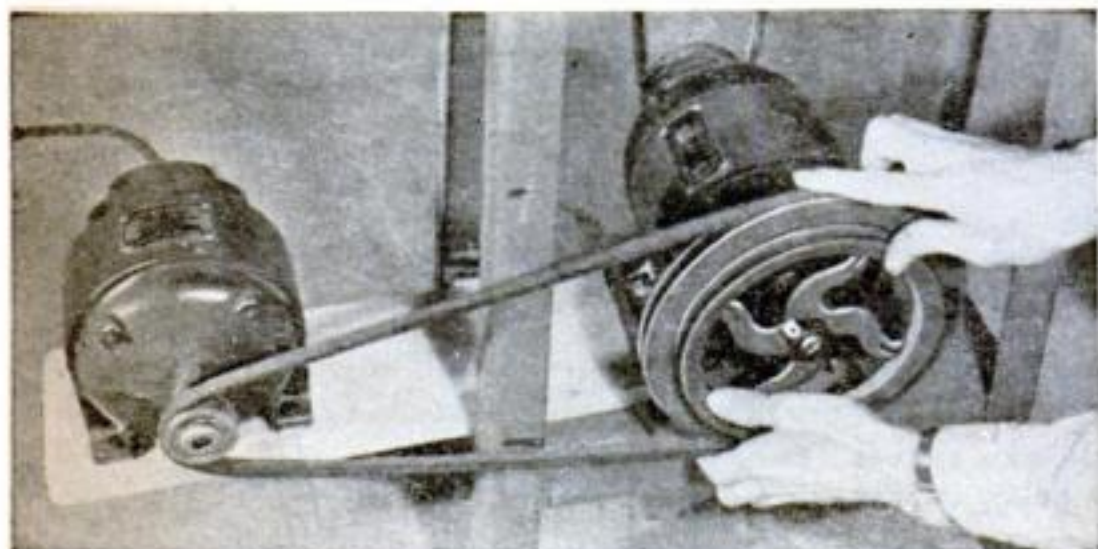


TOP VIEW

SIDE VIEW

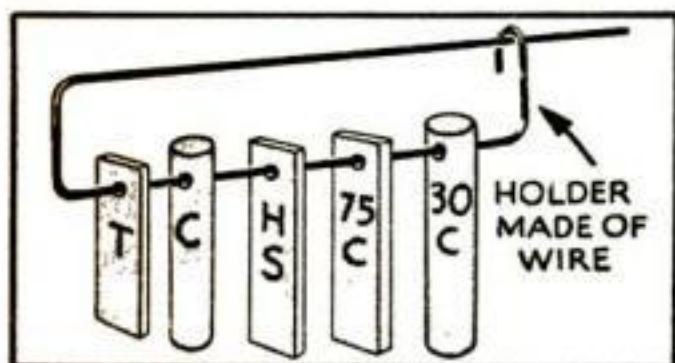
FULL SIZE

NEW SHOP IDEAS



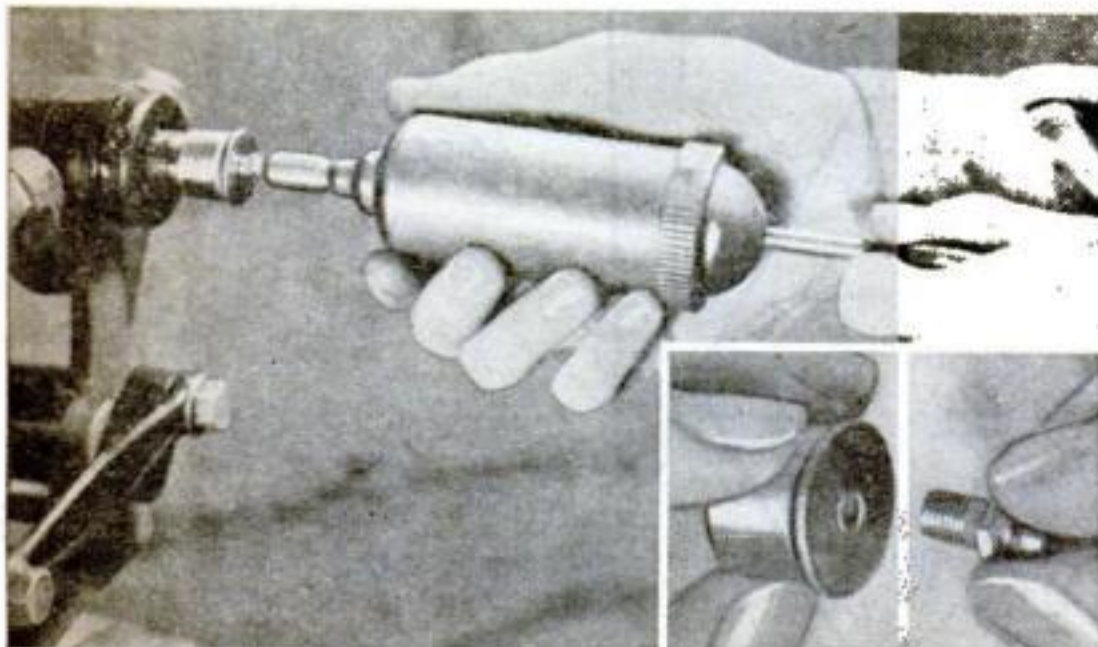
METAL-CUTTING SPEEDS can be obtained on a wood bandsaw with the saw motor running as a countershaft driven by a second motor. Provided the extra motor is on hand, this arrangement avoids disturbance

of the original mounting and permits switching from metal to wood cutting simply by removal of the belt. Step pulleys on both the saw motor and driving wheel would give a variety of speeds.—HENRY HANSCOM.



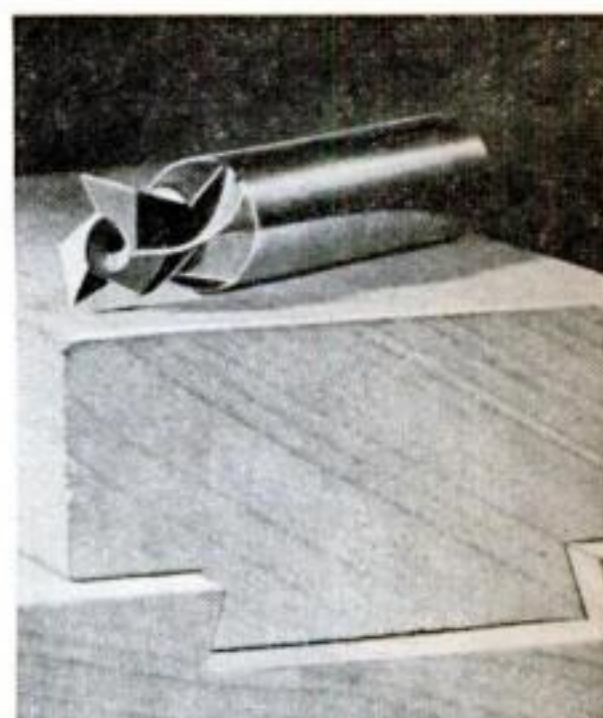
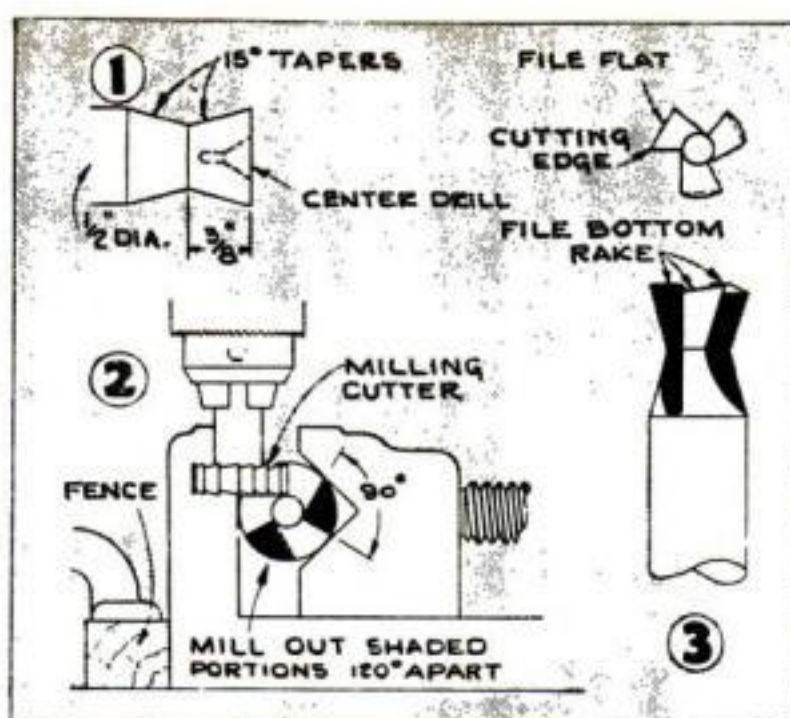
LABELED KNOWN SAMPLES of iron and steel, drilled and kept on a wire holder, help in identifying new stock. Compare sparks thrown off a wheel when grinding the new stock with those when grinding the samples. Labels may be such as T, tungsten steel; C, cast iron; H S, high-speed steel; and 75 C and 30 C, 75- and 30-point carbon steel.—RUFUS E. DEERING.

AUTOMOBILE GREASE FITTINGS inserted in holes drilled in the grease-cup covers of shop machines will permit quick refilling from a grease gun. The cup covers are simply backed off as far as possible, and the gun nozzle is applied to the opening of each fitting. Drill an undersize hole in each cup cover and tap it to take the threaded end of a fitting, or make the fittings cut the threads.—H. H.



A CHIP CHUTE of plywood made for the lathe bench provides an easy means of collecting chips and keeping them off the floor. If the lathe is used for both metal and wood, have two containers so wood chips can be kept separate and burned.—D. C. DOREMUS.

Tool Turned from Drill Rod Cuts Smooth Dovetail Joints



THIS dovetail cutter will make blind dovetail recesses in drawer fronts, as at left above, and smooth-sliding dovetail joints like that at right. It will cut both the tongue and socket in the latter piece.

Turn the cutter blank from $\frac{1}{2}$ " drill rod, as in Fig. 1, and lay out three equal divisions with lines at 90 deg. Clamp the blank in the drill-press vise, set up a small milling cutter (see PSM, Nov. '46, p. 175) as in Fig.

2, and slide the vise against a fence clamped to the drill-press table as above. File the side of each tooth to a flat angle (Fig. 3), using the file lightly to finish the edge, and then produce the bottom rake with a file, as also shown in Fig. 3.

Harden the cutting end, temper by heating the shank until the straw color travels to the top of the side teeth, and then quench immediately.—HERBERT PFISTER.

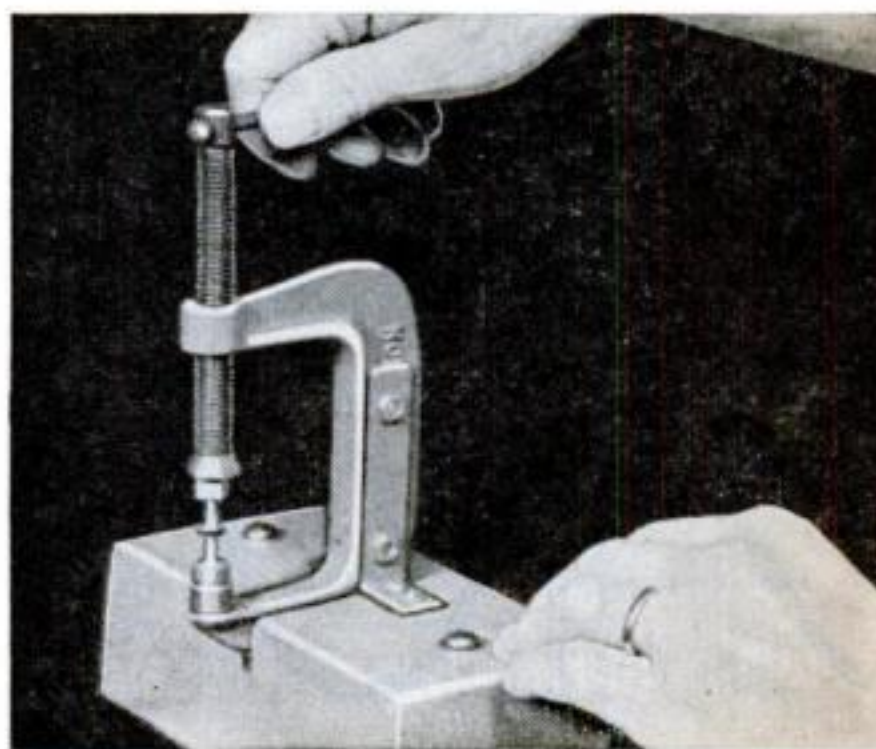
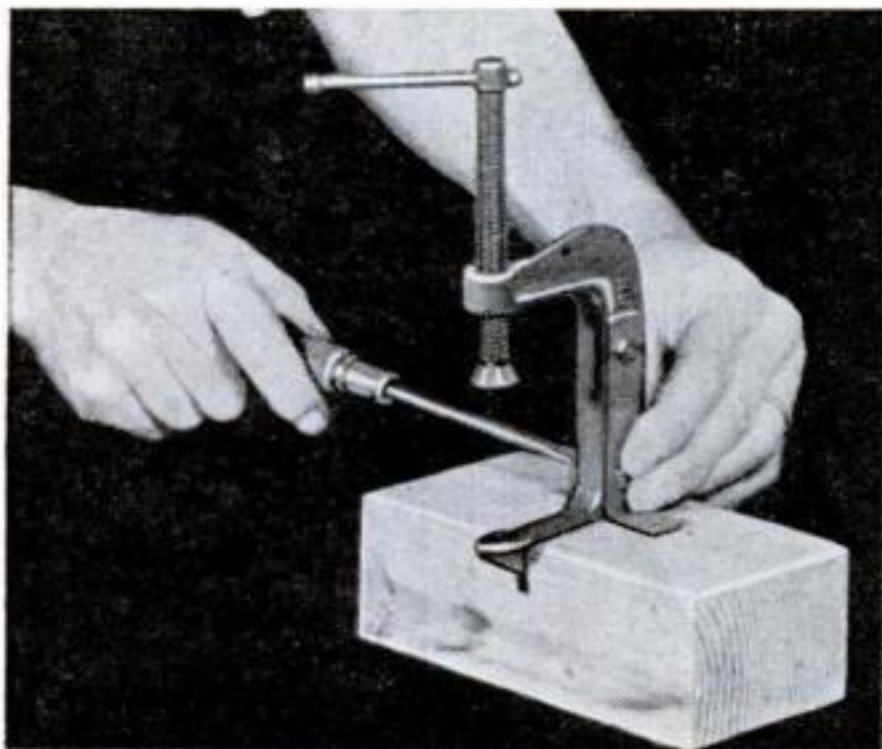
Arbor Press for Handling Small Work Is Made from C-Clamp

SCALED to modelmaking size, this little arbor press will push studs in or out and, in its own small way, do anything a large press can do. It consists of a $3\frac{1}{2}$ " or 4" C-clamp, preferably one of good quality, held to a slotted hardwood block with two angle brackets.

Recess the block with a chisel to take the clamp web at the stationary-jaw end snugly

up to the flange, and bevel the edges of the block. Drill bolt holes in the clamp frame, bolt it between the brackets, and screw the latter firmly to the block. Paint the clamp, brackets, and block machine gray, but take care not to get paint on the threads.

In use the press is bolted to the bench. Oil the clamp-screw swivel foot to make it work freely.—H. P. S.





D.C. from Your A.C. Lines

NEED DIRECT CURRENT?
IT'S YOURS WITH A LOW-
COST, EASILY ASSEMBLED
ELECTROLYTIC RECTIFIER.

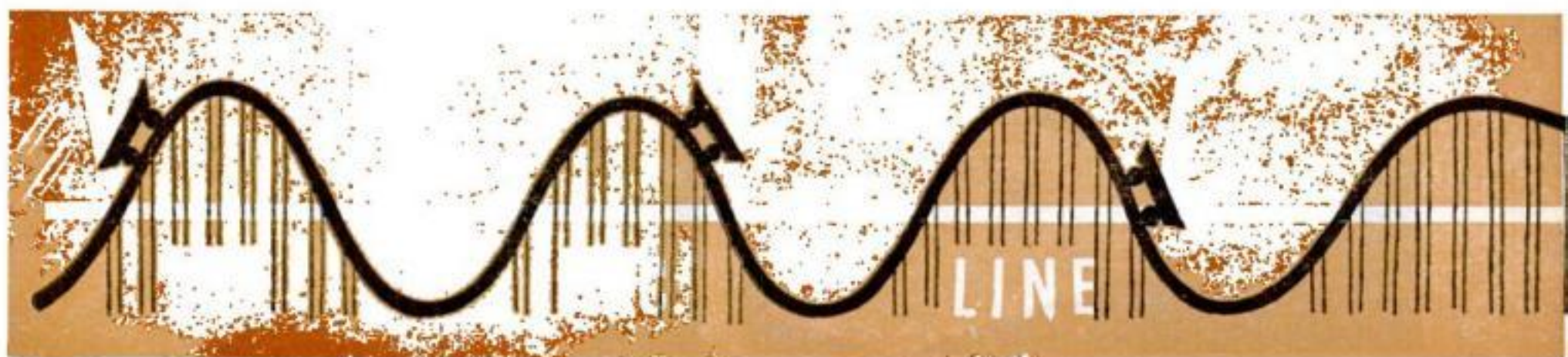
By Harold P. Strand

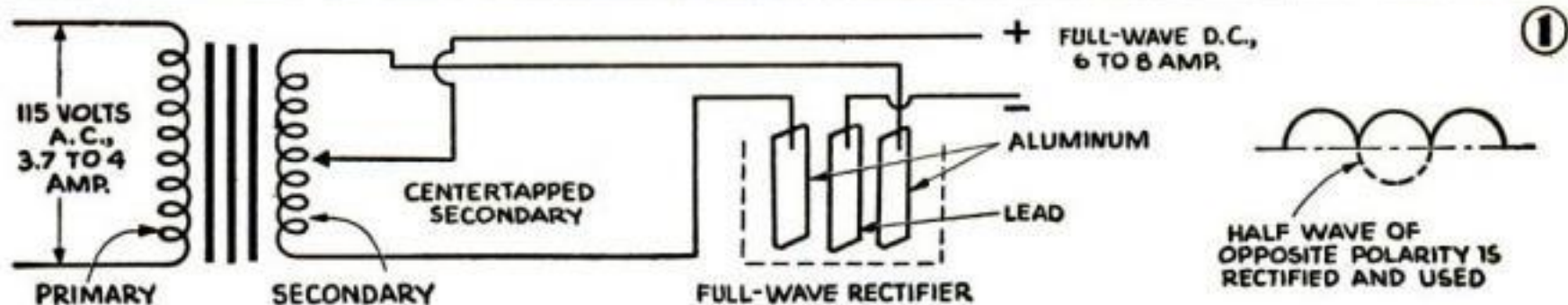
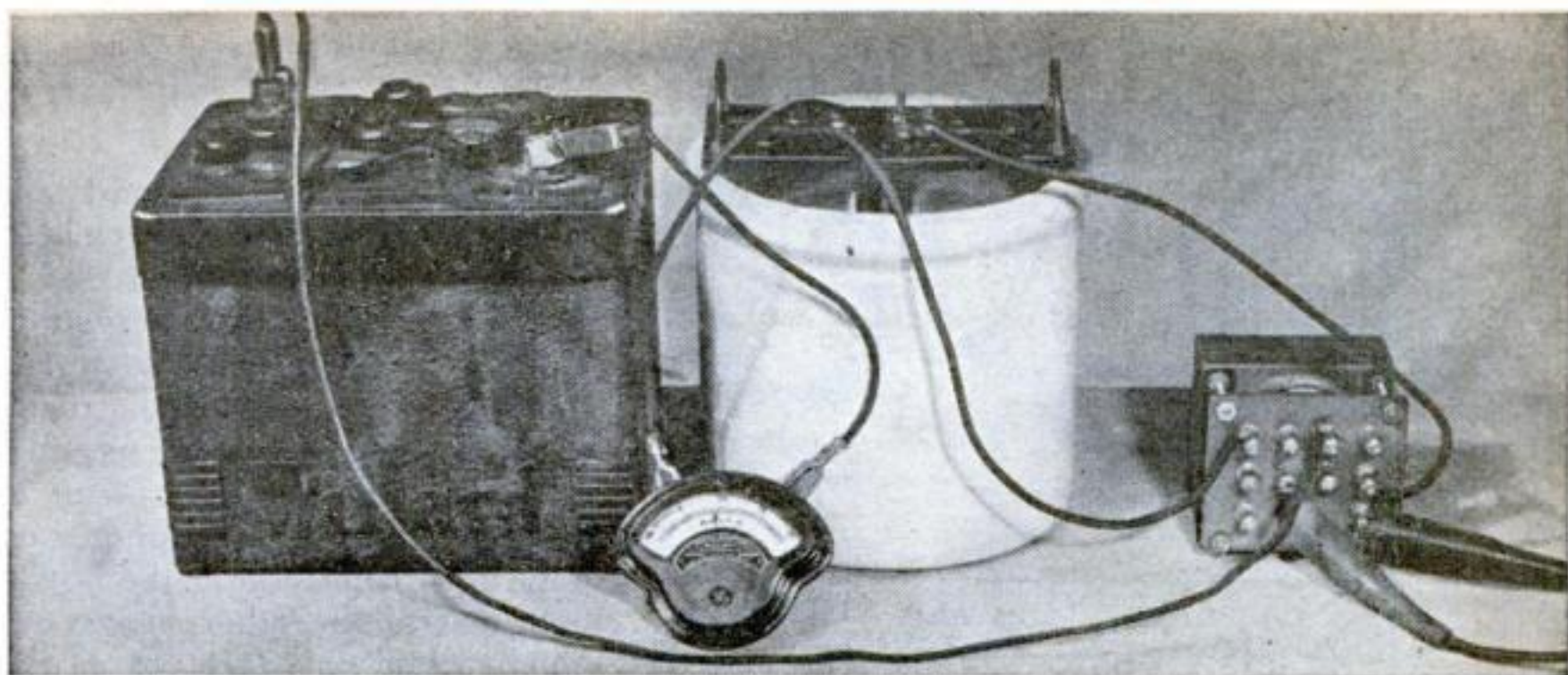
CRUDE as it may seem to engineers and the fortunate few who do their experimenting in well-equipped laboratories, the electrolytic rectifier can boast of advantages over its more efficient rivals. It is cheaper and easier to build than vacuum-tube, dry-disk, or motor-generator rectifiers, yet it is a reliable source of low-voltage D.C., useful for electroplating, charging batteries, and operating model railroads.

Practically all the needed materials will be found around the house or in the scrap box. Chief items are a resistance or transformer to drop the line voltage, a 1-gal. stoneware crock or jar, two small sheets of $\frac{1}{8}$ " aluminum, one of $\frac{1}{8}$ " or $\frac{1}{16}$ " lead, and a panel of bakelite or similar material large enough to span the mouth of the crock. Any one of several chemical solutions will serve as the electrolyte.

In the photo on the facing page, the rectifier is shown in operation as a battery charger. Maximum efficiency is obtained when a transformer with a centertapped secondary is used as shown in Fig. 1. The charging rate as indicated on the D.C. meter is 6 to 8 amp.; current draw from the line is 3.7 to 4 amp. Output can be varied by altering either the spacing of the plates or the input voltage. A transformer that can deliver 20 volts from either side to the center tap and 10 to 12 amp. without overheating is required. The wire marked with the "plus" sign goes to the corresponding battery terminal or to the anode (plating metal) in an electroplating bath.

For half-wave operation, either a series resistance (Fig. 2) or a transformer (Fig. 3) will serve to reduce the line voltage. In the first case, to get an equivalent charging rate





of 8 amp. would impose a line draw of 15 to 20 amp. because of heat losses in the resistance.

With a heating-unit resistance, shown in the photo at the top of page 182, a charging rate of 1.5 to 2 amp. is obtained at a line-current cost of 4 amp. Substituting a lower resistance will increase the output but it will also cause a sharp rise in the input.

A more flexible half-wave rectifier is made with a transformer capable of delivering 18 volts at 11 to 12 amp. Using the connections shown in Fig. 3, it is possible to obtain the relatively efficient charging rate of 5 to 6 amp. with only 2.6 to 3 amp. being drawn by the line.

To build the electrolytic unit, cut one lead and two aluminum plates as shown in Fig. 4, notching the two adjacent ends of one pair so that the plates can be brought close

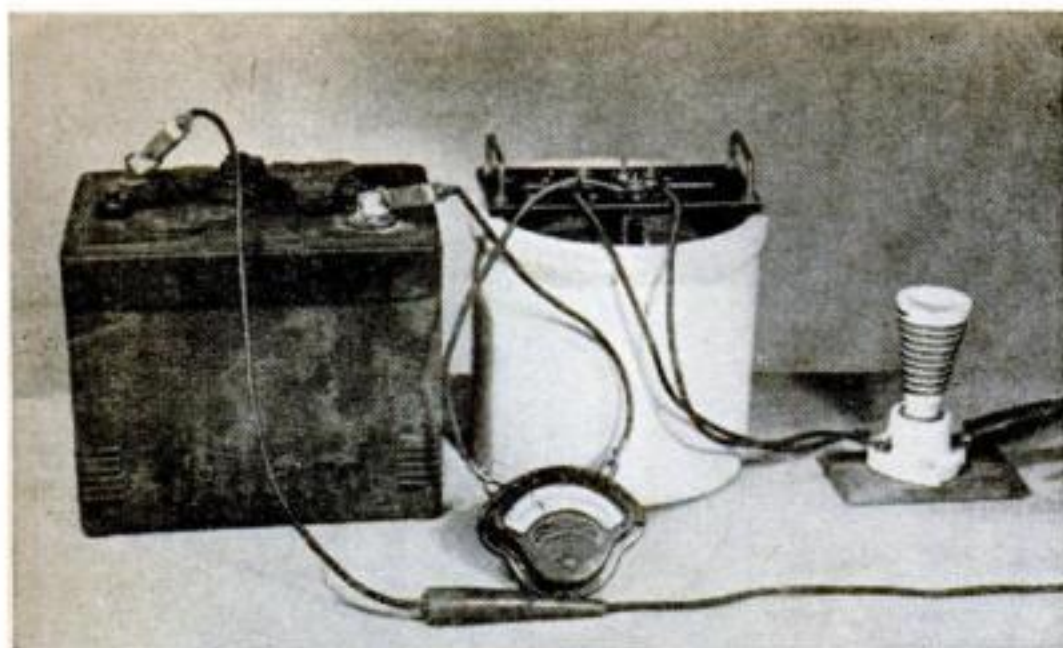
together without making electrical contact. A strip of bakelite or other insulating plastic is attached to each side of the lead plate as additional insurance against touching.

Assembly of the pieces presents no difficulties. The lead plate is attached to the panel with two 8-32 brass machine screws, and a knurled thumb nut is placed over one of the hold-down nuts to act as a terminal post for the negative lead. Use an extra thumb nut on the screw holding each of the aluminum plates.

Sodium phosphate, obtainable at any drug store, makes a suitable electrolyte. Ammonium phosphate and household borax are two of the other readily available chemicals that can be used. First prepare a saturated water solution—that is, add the phosphate or other chemical until no more can be absorbed by the water and it begins to settle out to the

RECTIFIER

THE D.C. LINE



When efficiency is not a factor, the use of the series resistance shown at the left is satisfactory. Wiring connections are given in Fig. 2, below.

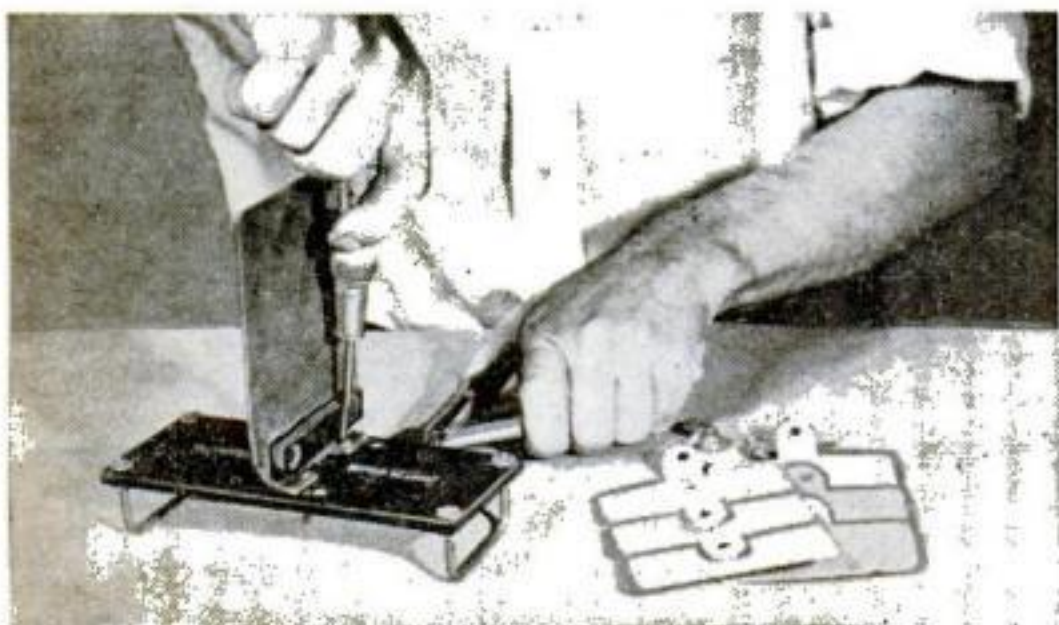
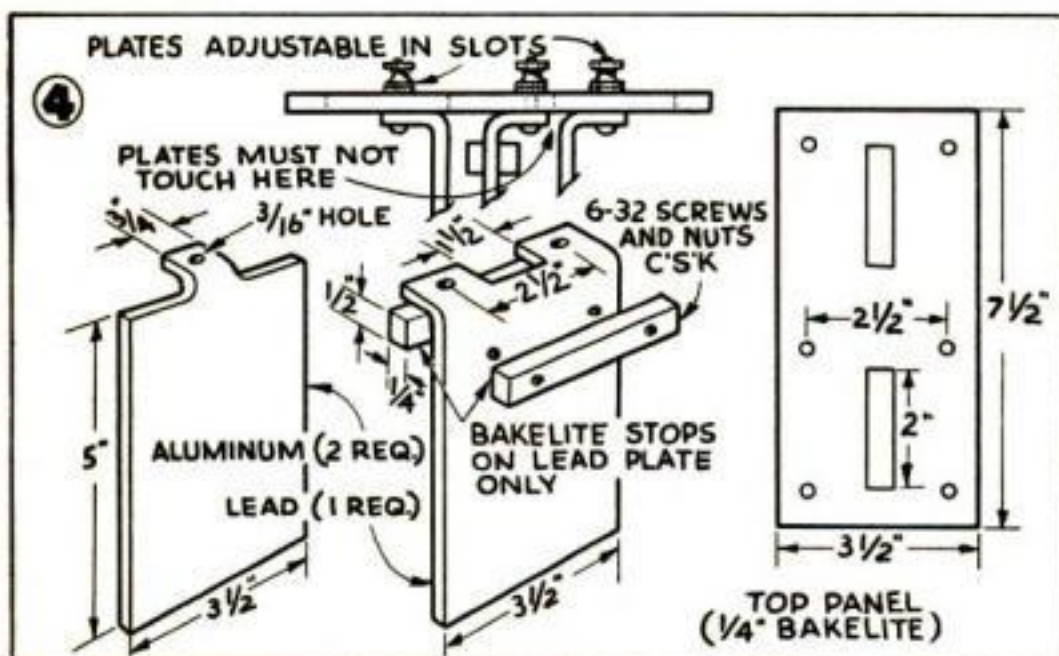
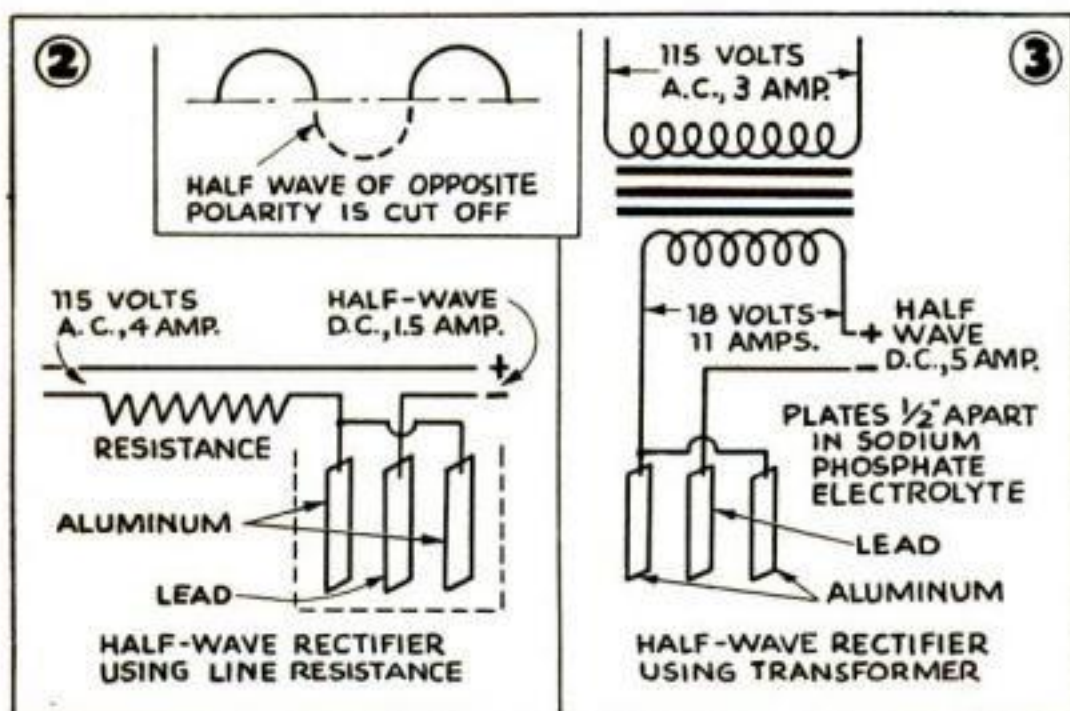
bottom. Stir the solution thoroughly and wait for it to clear; then pour it off into the crock.

With the plates submerged in the liquid, connect a wire to the binding post atop each plate. Join the outer pair at one terminal of a porcelain socket as seen in the upper righthand photo on page 183. One side of the power line goes to the other socket terminal, while the other side of the line and the wire from the lead, or center, plate constitute the output or charging lines.

Add a teaspoonful of table salt to a glass of water and place the bared ends of the output wires in this solution. When the power is turned on, tiny bubbles will be seen to form around the wire coming from the lead or negative plate. Touch the wires together and bubbles will begin to form around the aluminum plates. Hold the connection for about 20 minutes to permit a film of aluminum hydroxide to form on the positive plates. This film, acting as a rectifying agent, offers extremely high resistance to the flow of current in one direction and a low resistance in the other.

To measure output voltage, set up a complete circuit so that current will flow; this can be done by connecting a resistance across the rectifier and measuring the voltage across this load. An ammeter in series will tell the current in the circuit.

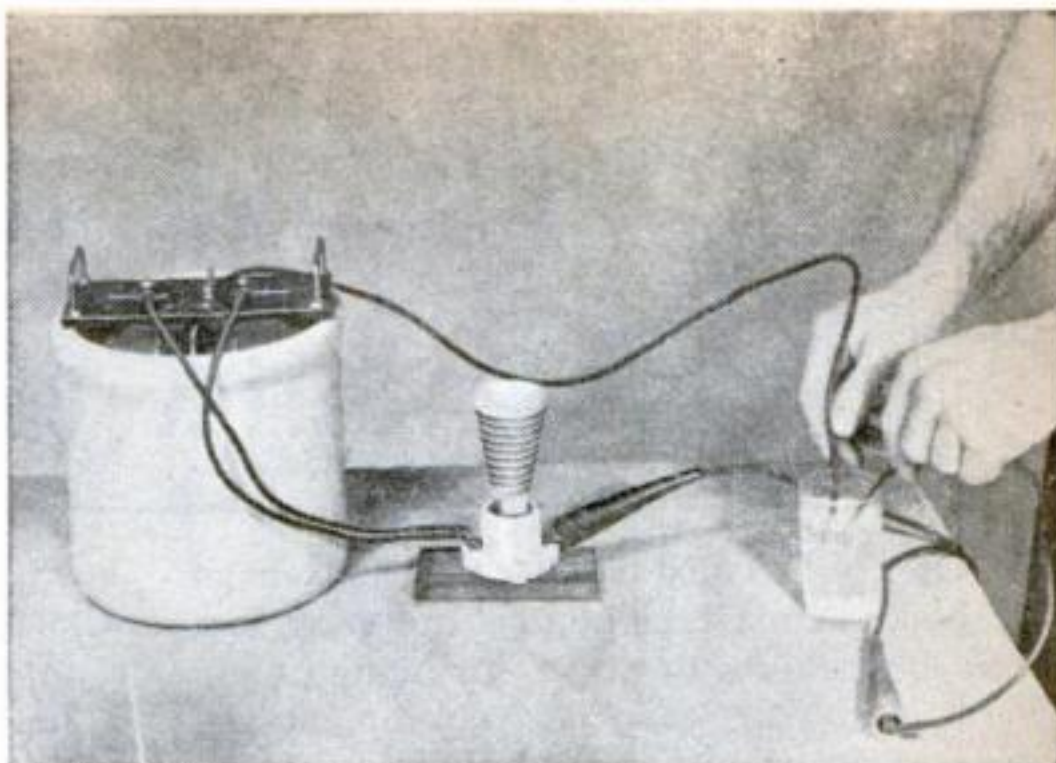
Servicing boils down chiefly to the problem of offsetting the effects of chemical action. Connections are liable to corrode, especially where screw heads make contact with the plates; the aluminum plates may also wear out



At left, attaching the lead plate with brass machine screws. Note the handles on which the panel rests; simple knobs can be used in place of the handles.



Mix the chemical and water in a saturated solution, stir it well, allow the liquid to clear, and pour it off into the crock.



When both leads are submerged in a salt solution, bubbles will form around the negative wire. Short-circuit the wires to permit a hydroxide film to form on the aluminum plates.

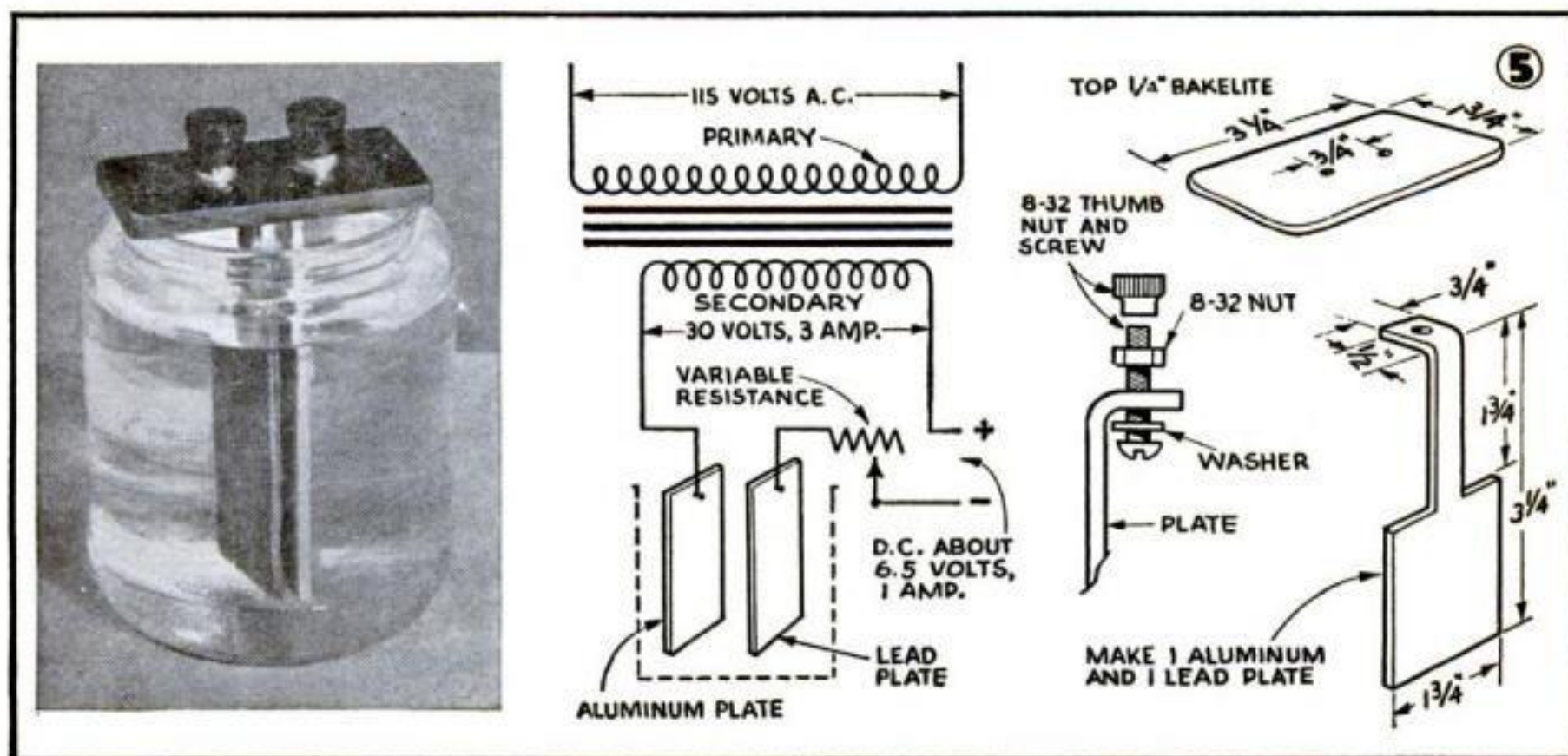
and have to be replaced. Clean the plates from time to time and repeat the forming process to allow the hydroxide film to form again. When the solution shows signs of persistent overheating, and the charging rate cannot be brought up to scratch, it is time to throw out the old liquid and prepare a new batch.

In continuous operation the solution will gradually rise in temperature. If it becomes too hot, or if a heavy current is being drawn, place the crock in a larger vessel and allow a stream of water to run in the space between.

For experimental use, where low-voltage, short-duration D.C. is needed, a simple electrolytic rectifier is illustrated in Fig. 5 and the photo below. Two plates provide half-

wave rectification; the container is an empty fruit jar of about 1-qt. capacity. One lead and one aluminum plate, spaced about $\frac{1}{4}$ " apart and supported by 8-32 screws and nuts, constitute the vital parts. The same electrolyte may be used in this outfit as in the larger one.

Since the output of the smaller unit is low at best, it should be used only with a transformer. A heavy-duty toy train transformer able to deliver about 30 volts in the secondary should serve nicely. With the latter input, an output of about 1 amp. at 6 to 6.5 volts can be obtained. The output can be raised somewhat by using a higher input voltage, but if more service is required of the rectifier, it would probably be better to build the larger one described above.





Putting an Old Tripod Back on its Feet

BROKEN-DOWN tripods that look as if their picture-taking days are over can often be rebuilt to serve for many more years. And with good new equipment still scarce, even extensive rehabilitation may be worth the effort. The illustrations below show the most commonly needed repairs.

Start by examining the top carefully for cracks, holes, and loose screws. Minor cracks in metal tops can be stopped by drilling a small hole just ahead of the split. More serious damage requires soldering, or brass reinforcing plates held with machine screws. In wood tops, use plastic filler to plug cracks

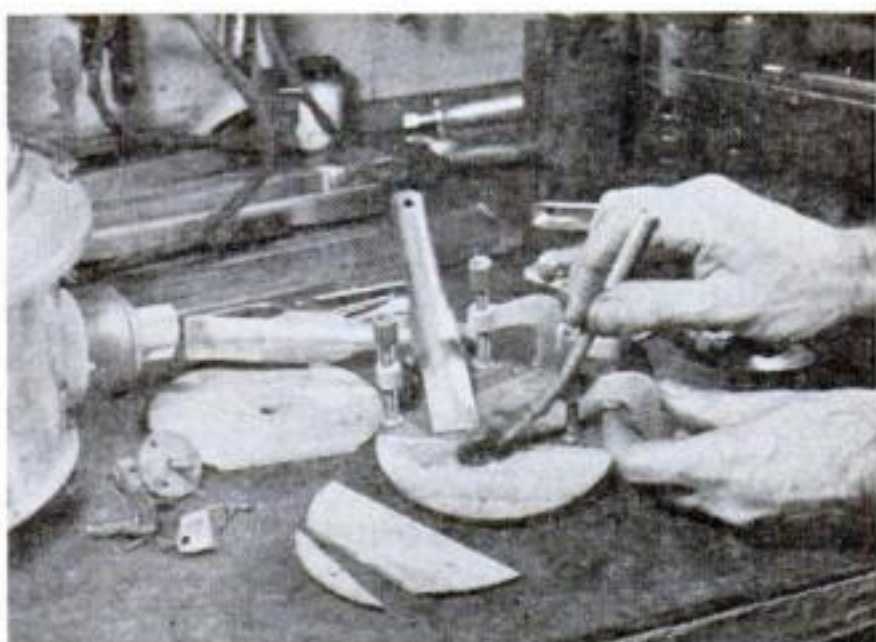
and pack loose screw holes. Sometimes the whole top may have to be separated into its component plies and reglued.

The screw fitting the camera socket, subject to much hard wear, frequently must be replaced. A standard $\frac{1}{4}$ "-20 bolt can be used, or a special screw having these threads made up in the lathe with either a knurled head or a transverse pin as a finger grip. To keep the screw from coming out of the plate, form a neck on the screw as shown in the drawing, thread the plate, and burr the threads in the plate after the screw is on. Or make up a plate of metal disks with cen-



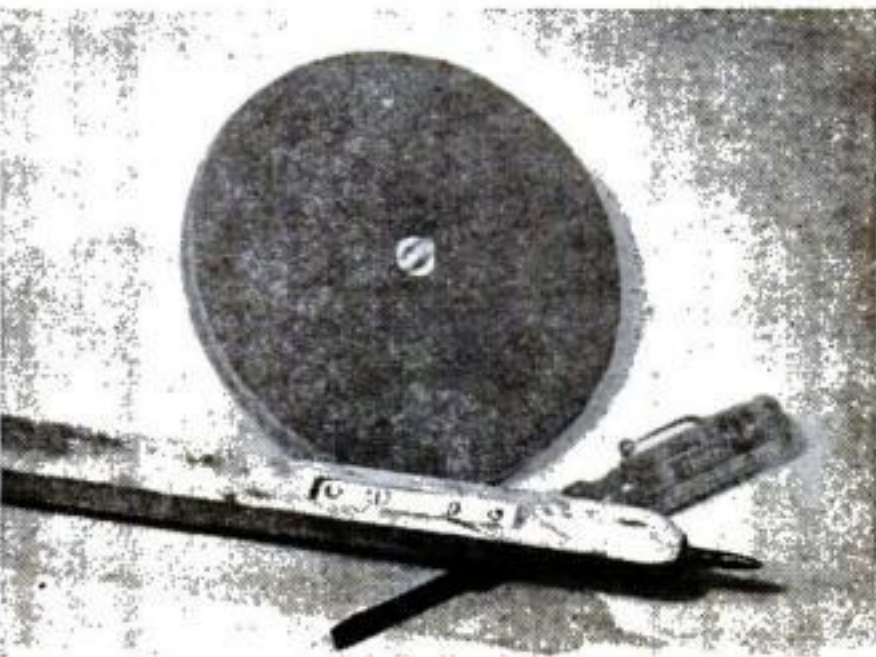
Splits in metal tripod legs are fixed by soldering the break over a porcelain tube and filing flush.

To restore brightness to tarnished brass hardware, dip in nitric acid and neutralize in washing soda.



Open plies in wood tops are separated, sanded clean, and reassembled after coating each with glue.

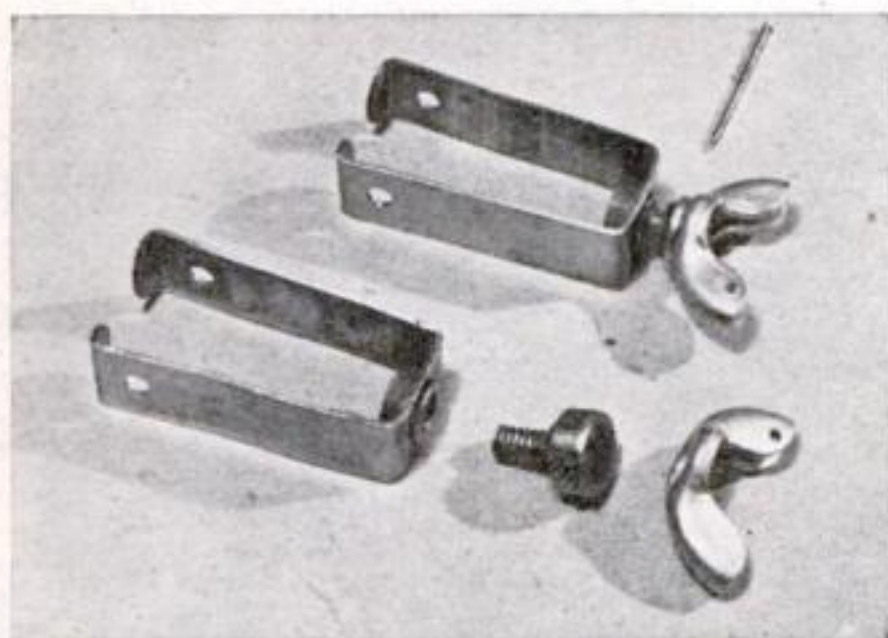
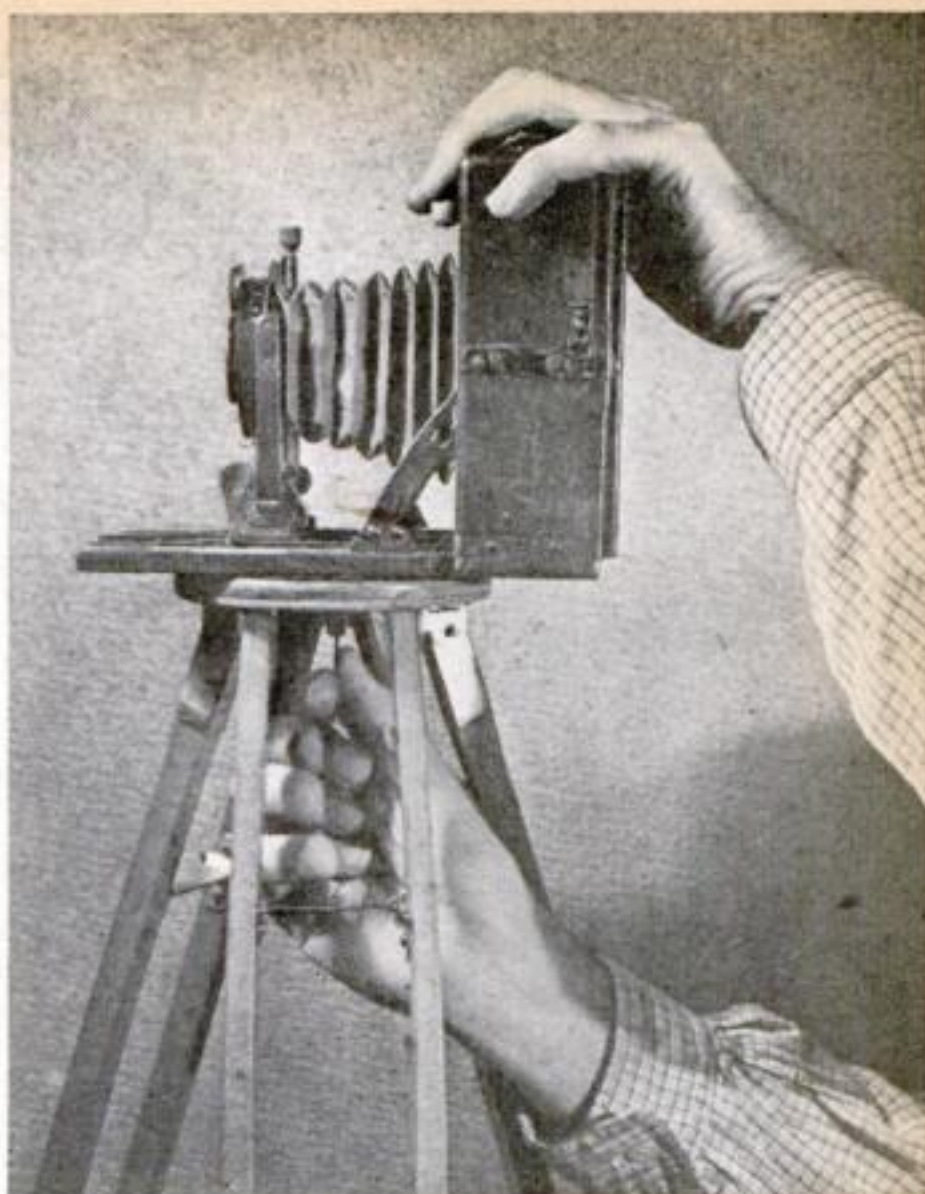
Broken legs should be carefully glued together and reinforced with dowels or recessed brass strips.



tral holes just large enough for the screw shoulder, but too small for the threads. Both disks, slit from edge to hole, are bent to slip around the screw and then flattened and fastened to the tripod top.

Other parts that often wear badly are knurled knobs. Sore fingers can be avoided by turning down the screw head and soldering on a wing nut. In many tubular metal tripods, push-button catches adjust for height. They can be removed for repairs, if necessary, by disassembling the legs, removing the pin in the spring, and pulling out the spring and button. The legs of metal tripods may also have dents that cause them to stick. Hammer out the dents, using a metal rod as an anvil.

Secondhand wood tripods generally need refinishing. Remove the old finish, sand rough spots and sharp edges, and apply varnish or linoleum lacquer, or rub with boiled linseed oil. Leave sliding surfaces unfinished, lubricating them with wax or soap.—ERWIN WALTERS.



With split top, broken leg, and worn fittings, this tripod went for a quarter at an auction. But only a few hours' work readied it for hard service again.

Screws on the height-adjusting clamps were rebuilt better-than-new by shouldering down the heads on a lathe, and then soldering on wing nuts.

The sketches below illustrate several methods for making commonly needed repairs to height-adjustment fixtures and tops on wood and metal tripods.

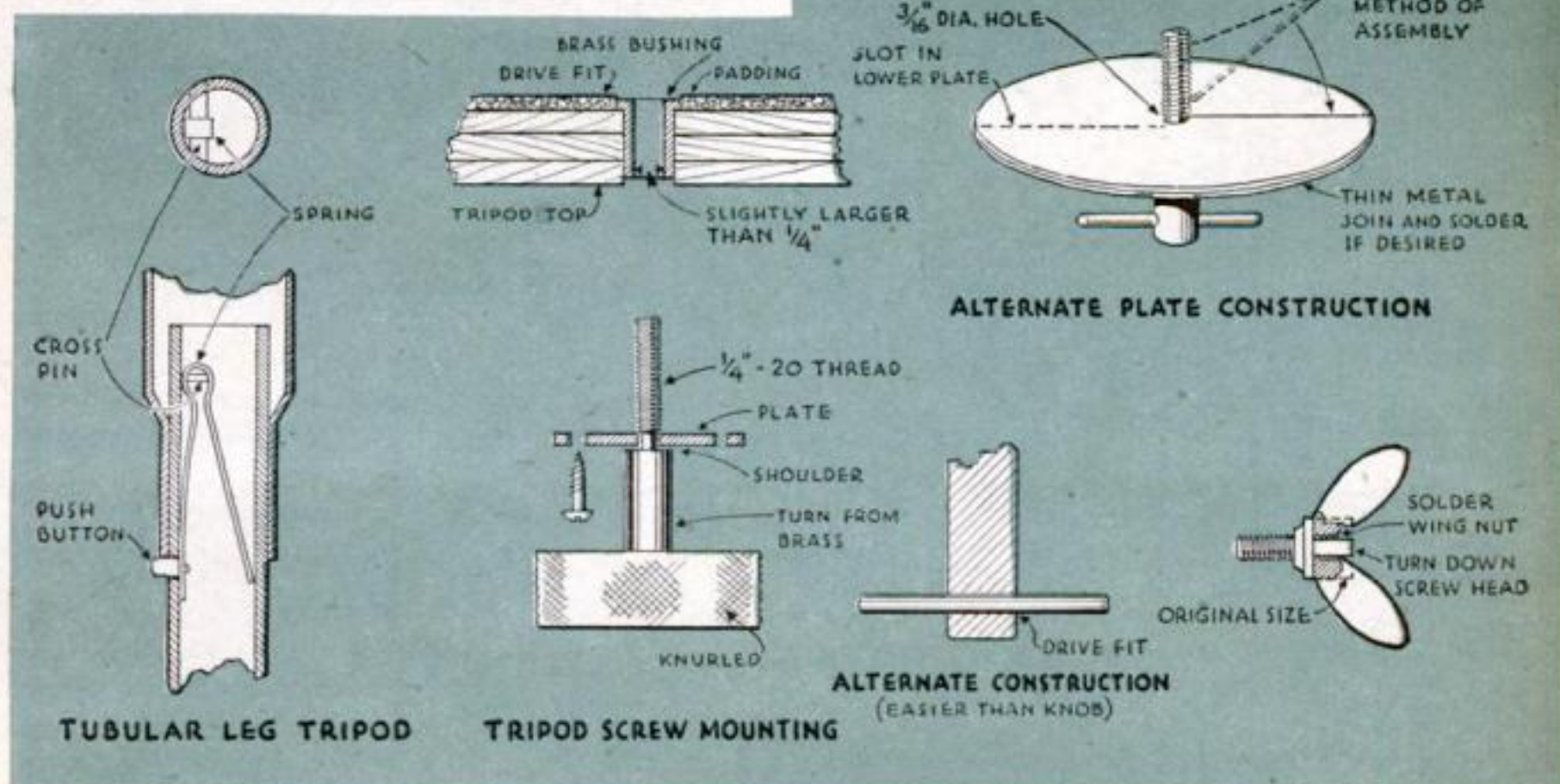


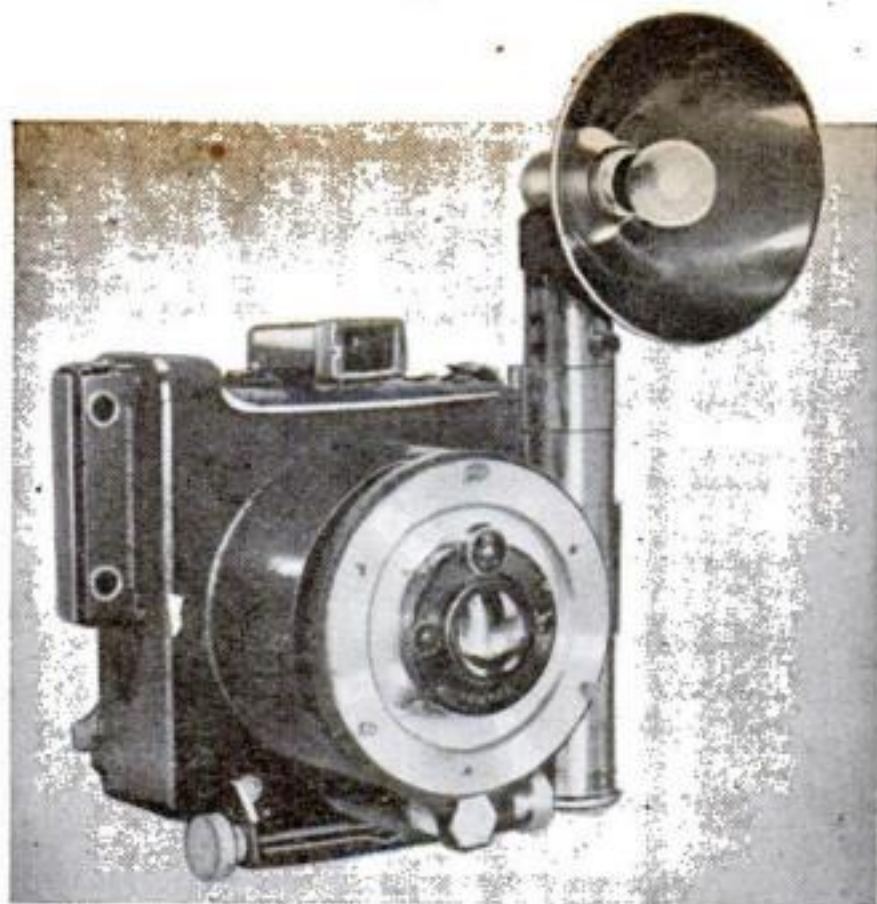
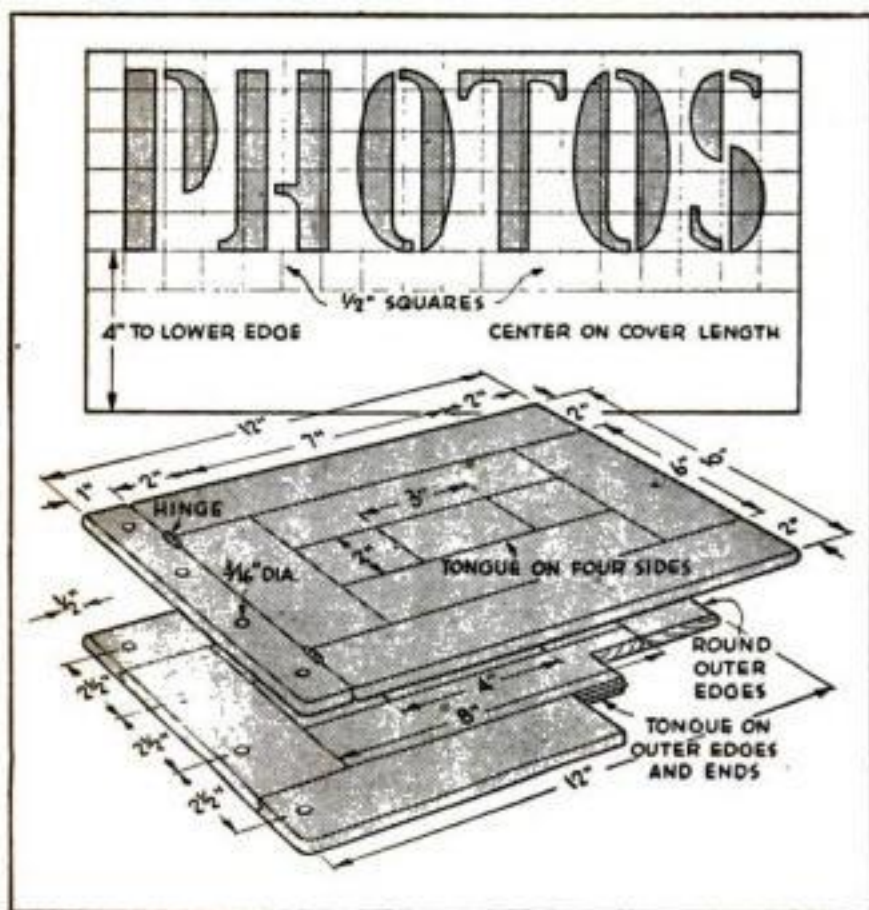
PHOTO IDEAS and EQUIPMENT



REFLEX FOCUSING of miniature cameras, instead of eye-level operation, is possible with a new view finder equipped with a 50-mm. lens and an automatic focusing arm that moves with the camera lens. The ground glass is masked to show a picture area the size of standard color film, and the mask moves with the lenses to correct for parallax. DeMornay-Budd, of New York, makes two models—to fit Leica and Contax cameras—and plans them also for other miniatures.



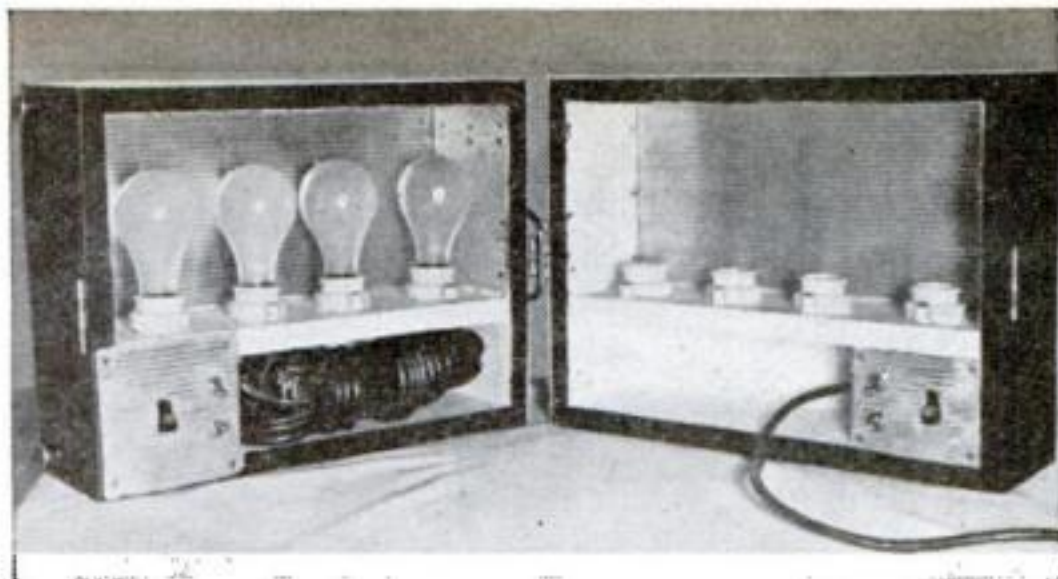
WOODEN ALBUM COVERS can be built up of tongue-and-grooved strips glued at right angles to prevent warp. Make the front cover 1" shorter than the back to allow for a 1" hinged binder. Surface all parts to $\frac{5}{16}$ " thickness. Decorate the front with a title; the letters are glued on as overlays of thin wood and may be painted to contrast. Lace through the holes and filler sheets.—E.M.L.



METAL "BELLOWS" in the form of a telescoping lens mount are provided on two new Printex press cameras—a 4" by 5" size and a 2 $\frac{1}{4}$ " by 3 $\frac{1}{4}$ " "mini-press." Both models are supplied with a recessed metal lens board taking a wide-angle 3 $\frac{1}{2}$ " lens or reversing to take 6" or 6 $\frac{1}{2}$ " lenses. An optional flat board is for 5" to 5 $\frac{1}{2}$ " lenses.

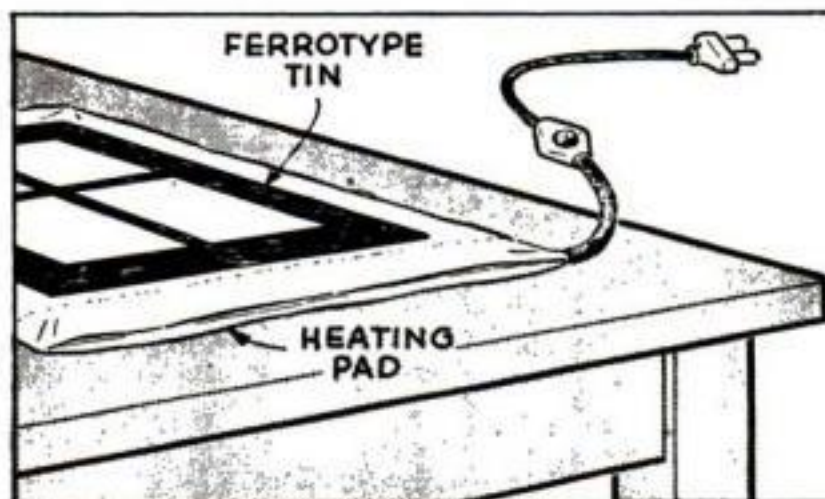
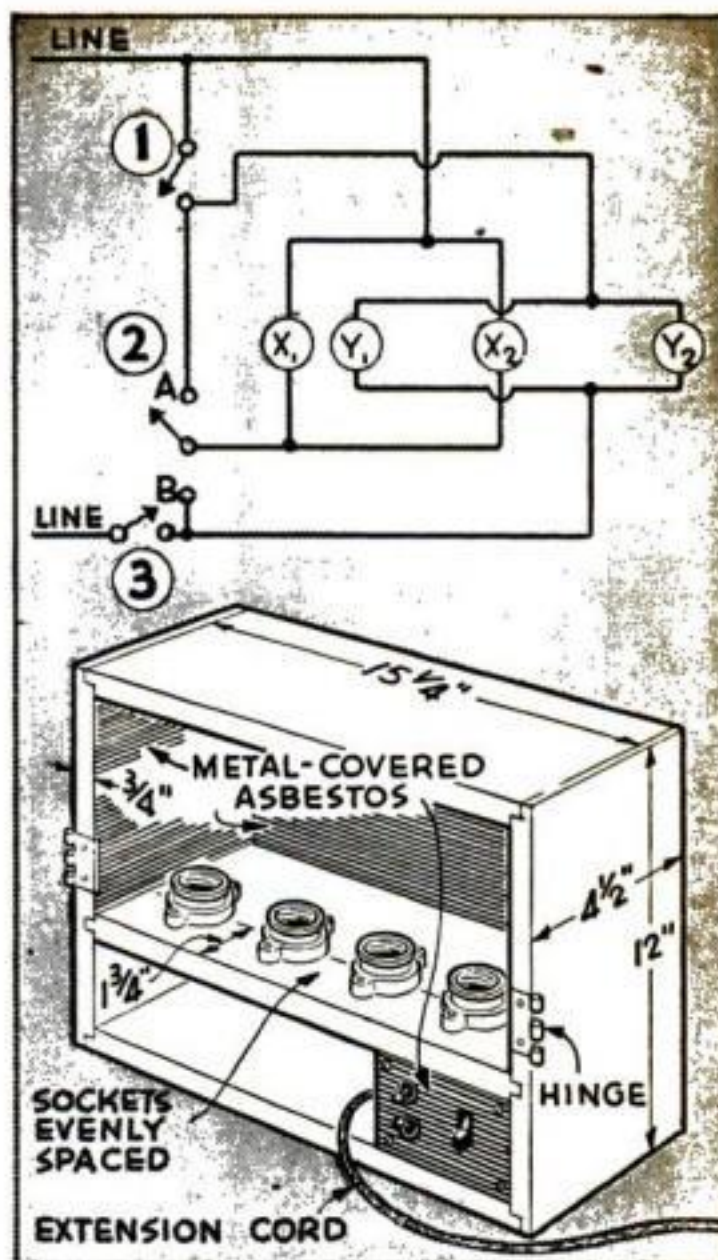


COLOR CORRECTION in light is simplified by use of a meter scaled for Harrison & Harrison's set of 22 filters. Source light reflected from a white card is viewed through the meter, which is rotated to show red in an indicator window and further rotated until the color turns almost completely blue. The designated filter for the film being used is then taken from the scale. Two flanking indicator windows provide checks. One should show a definite blue and the other a tinge of red.

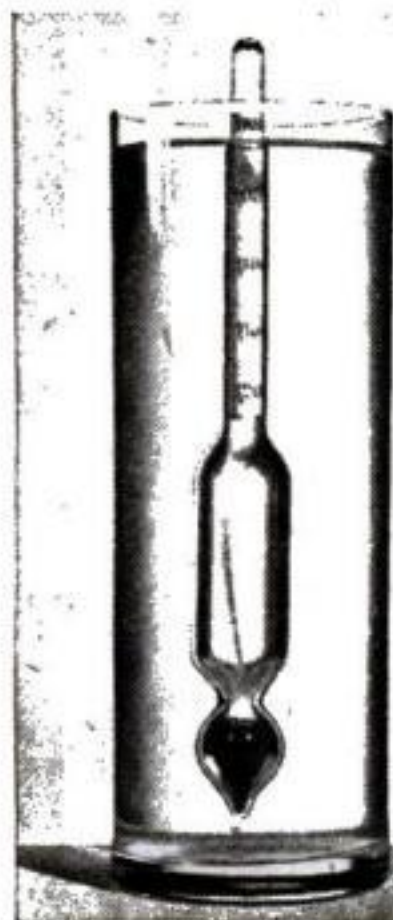


TWIN PHOTOFLOOD BANKS having a variety of light combinations can be built of ordinary equipment. Identical housings with hard composition-board backs are locked by pull-pin hinges to form a portable case. A reflector lining of metal-covered asbestos stove pads prevents scorching. Use No. 1 photoflood bulbs only and switches and wire that will carry 10 amp.

With the line switch (No. 3) closed, the combinations are: No. 1 closed, No. 2 at B, all lamps bright; No. 1 open, No. 2 at A, all lamps dim; No. 1 open, No. 2 at B, x lamps bright, y out; and No. 1 closed, No. 2 at A, y bright, x out.—R. A. BREWER.



SPEEDIER PRINT DRYING results if the ferrotype plate on which prints have been rolled is placed on a heating pad. Take care not to bend the plate and loosen the prints when moving it. Turn the pad on high, and when it gets warm, turn to medium.—W. E. DANNEMAN.



GLYCERIN BATHS are frequently used for final print rinsing to prevent curling and brittleness from excessive drying. The same solution can be employed over and over again if checked with a hydrometer and kept at proper strength.

Use a hydrometer designed for liquids heavier than water and having a low scale. For a 5-percent solution, add glycerin to the bath until the hydrometer registers 1.01; for a 10-percent solution, 1.02. Hydrometers may be obtained at a laboratory-supply house.



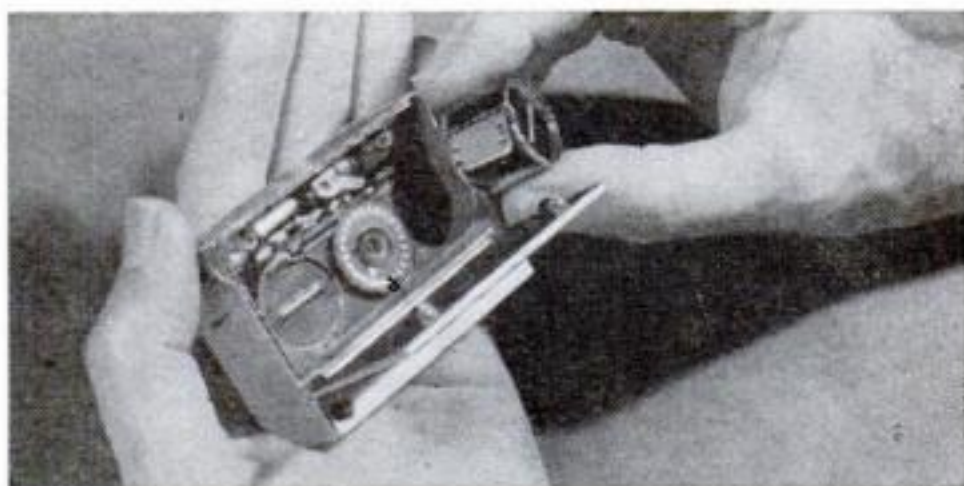
CAMERA VIBRATION can be minimized in a shop, factory, or the like if each tripod foot is cushioned with half of a sponge-rubber ball. Several thicknesses of rubber from a kneeling pad may be used just as well.—KENNETH MURRAY.

Still Camera Smaller Than Cigarette Pack Uses 16-mm. Film



TRULY vest-pocket in size, a camera smaller than a package of cigarettes takes 24 pictures on a cartridge of 16-mm. film. The Micro 16 has a universal-focus lens with three diaphragm stops that focuses objects sharply as close as 3'.

A small trigger on top of the camera operates the shutter, while a plunger on the side advances the film, at the same time moving the internal frame counter. The special film cartridges are enlarged to 2½" by 3½" prints without additional charge by the manufacturer, William R. Whitaker Co., Hollywood, Calif.



Cabinet Conceals Darkroom Workbench

THE problem of finding darkroom space in small homes and apartments is answered neatly by the "Photo-Bar," a walnut cabinet that conceals hypo and developer instead of Scotch. The top opens to provide a well for three trays, a firm base for the enlarger, and an eye-level cupboard for the timer and safelight.

Inside the wide doors are shelves that can be set at various heights to make economical storage space for bottles of all sizes. A towel rack is mounted on the back of one door, and a paper safe is built in beneath the enlarging easel. Other equipment includes a drain, a box for graduates and thermometer, and a lock. The Hi-Standard Manufacturing Corp., Baldwin, L. I., N. Y., makes it.



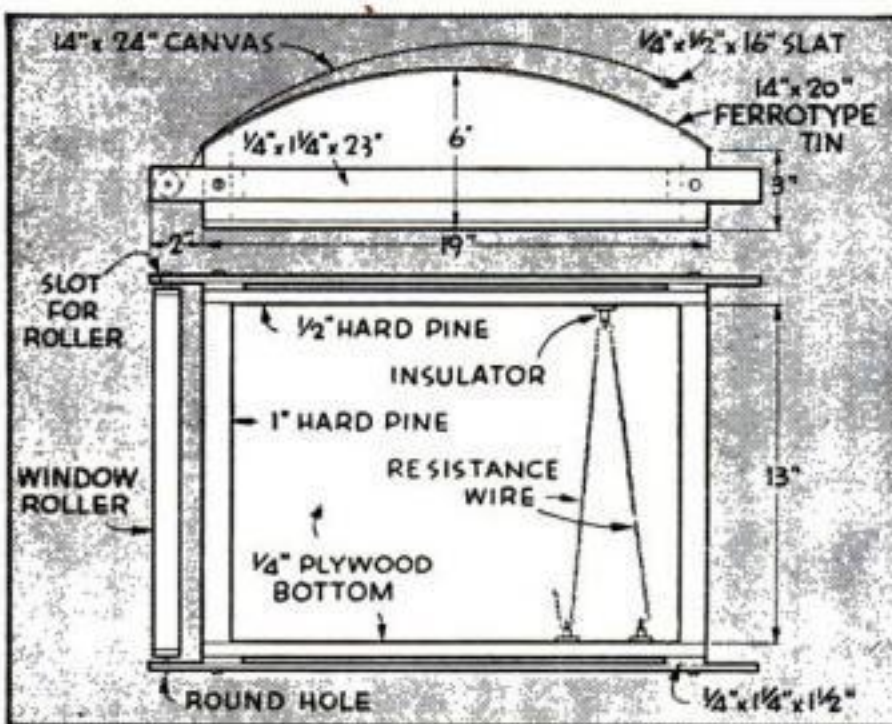
FIVE-MINUTE PRINT DRIER



H EAT for this print drier is furnished by two 660-watt coil-type heater elements connected in series. These elements are generally available as replacements for use in heaters or hot plates. Stretch each coiled

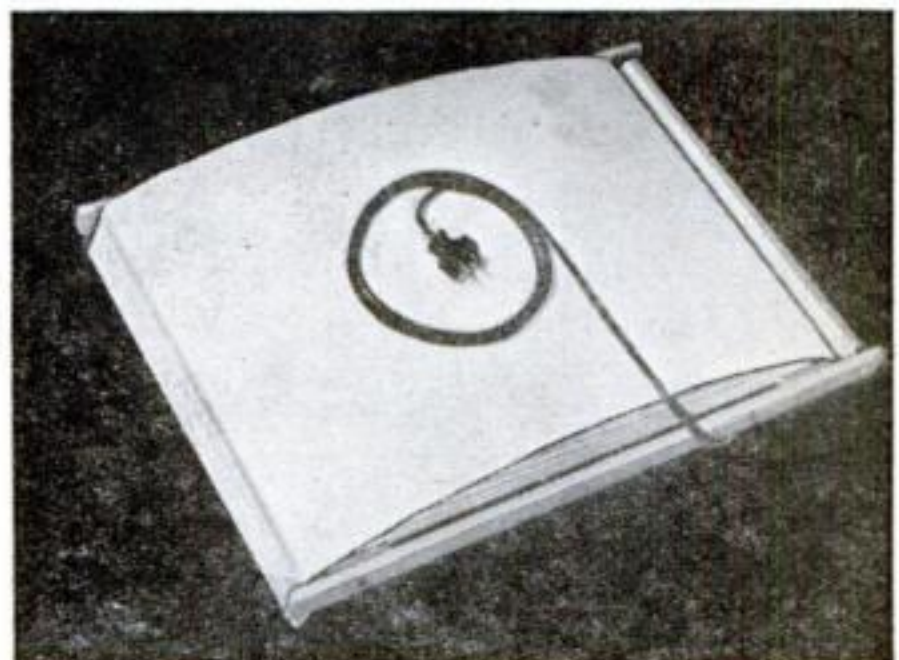
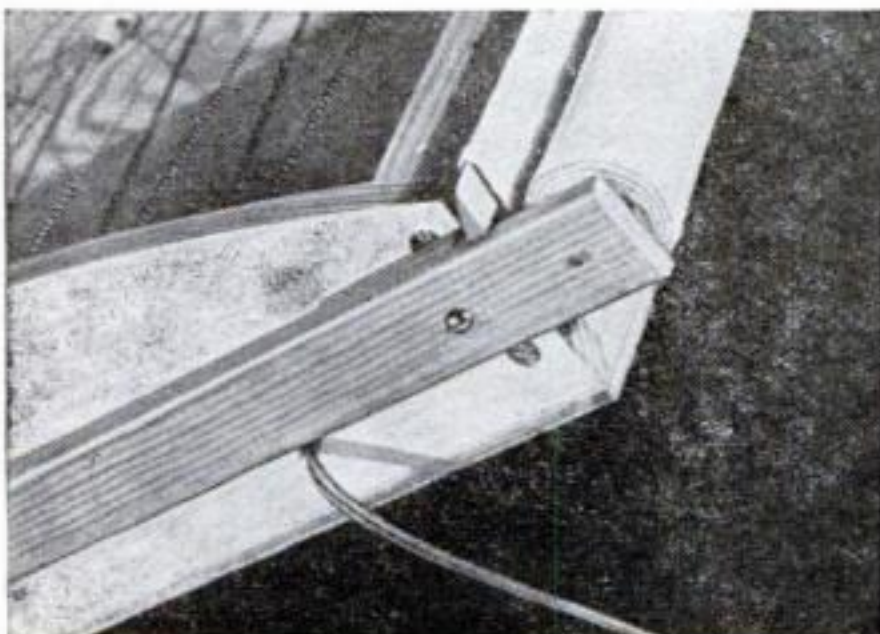
wire to 50", and connect them together. Every 10" form a loop that will accommodate the machine screw on the end of a stand-off insulator. Eleven of these, which are obtainable at radio supply stores, are aligned 2" above the base to hold the wire. If a line switch is used, be sure it will handle 5 amp. at 115 volts (the actual current draw will be around 3 amp.).

Line the box with sheet asbestos and attach the ferrotype tin with flathead wood screws driven down flush with the metal. A window-shade roller, its pawl removed to give constant spring tension, holds the canvas cover. To use, place glossy prints face down on the warm, wet tin; squeegee them, and leave under the cover for about 5 min. after pulling it forward and hooking under the projecting ends. Matte prints may be dried face up.—GEORGE O. SMITH.



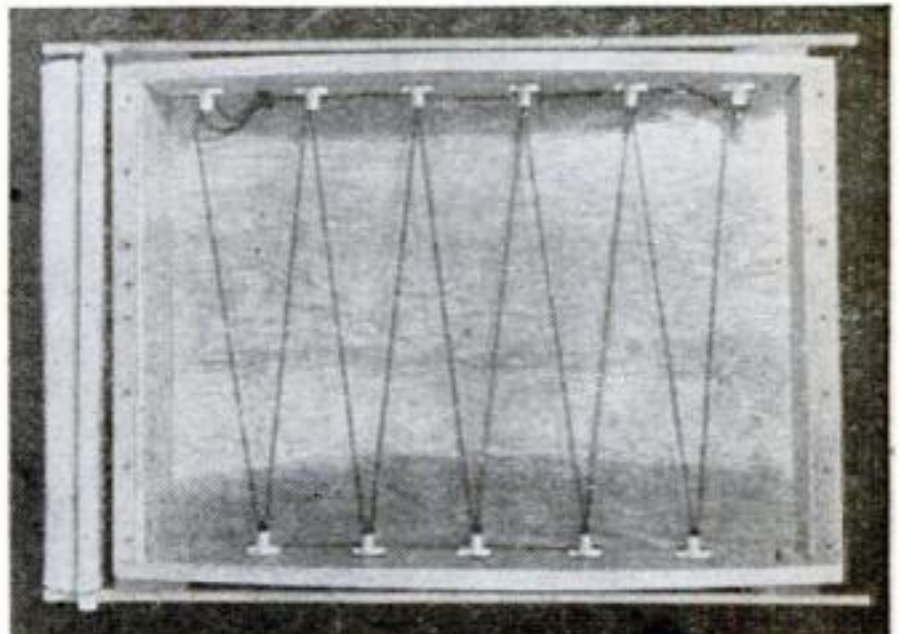
Since dampness will occur on and near the drier, shellac all of the wood parts before assembling.

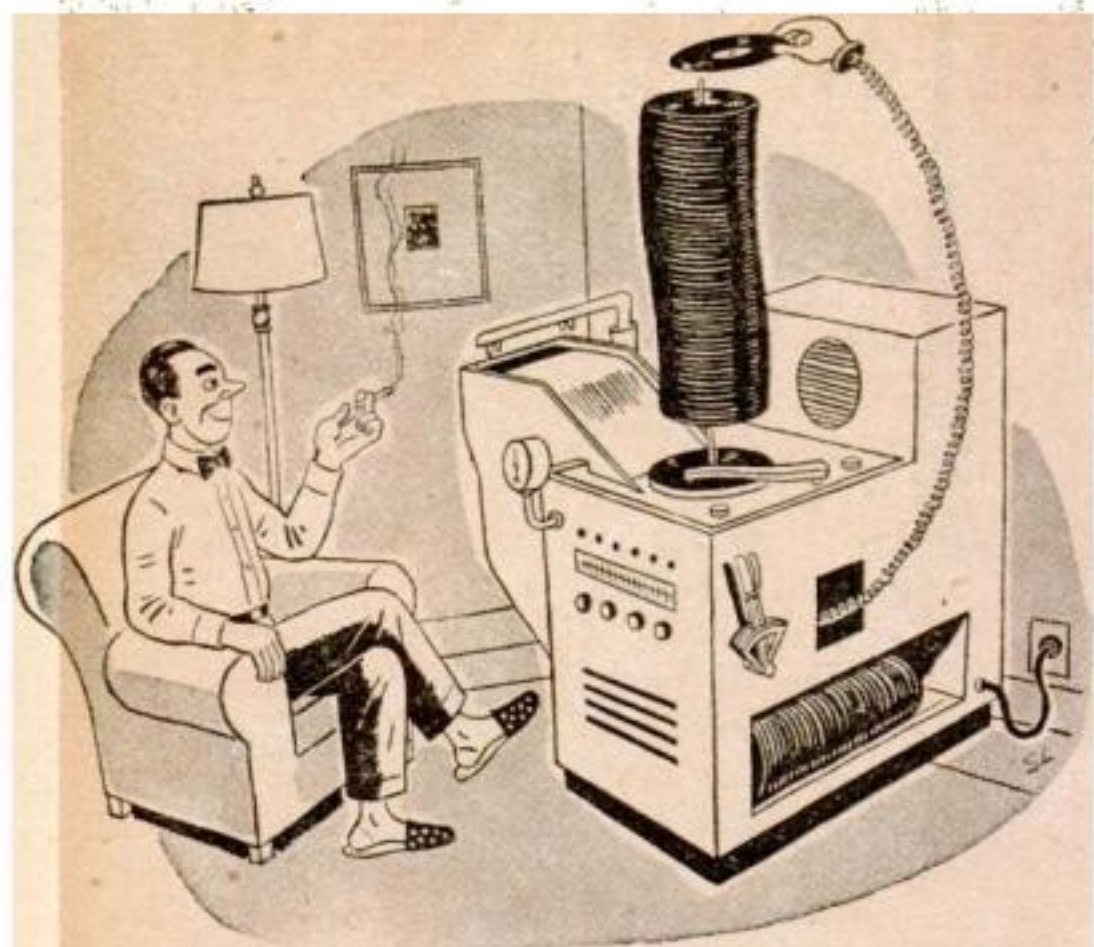
Bevel the end pieces of the box to suit the curve of the tin. The roller is mounted as shown below.



A slat hooks under the projecting side pieces to keep the canvas tight while the drier is in use.

Insulators for the wire are spaced evenly on each side. The cord goes through a hole at one corner.





LET Record Changers MAKE MUSIC FOR YOU

They can be used with any radio to take the labor out of listening.

By HARRY R. HYDER

ACCORDING to current estimates, 300,000,000 phonograph records will have been made in 1946 by the time New Year's Eve rolls around. Forget about the hundreds of millions of records left over from past years, and you still have a lot of work for the music-hungry public that has to feed this endless stream of disks into America's 8,000,000 phonographs. If each of these records were played only once—and we know that the average is many times that—you'd still have too many operations for a traditionally mechanical and labor-saving nation to take in its stride.

Of course the problem isn't new, and necessity has long since mothered her

inventions, but technology and increasing public demand are still working at the job of rearing that once-awkward child, the record changer, into a respectable member of our gadget family. Altogether, they haven't done too badly.

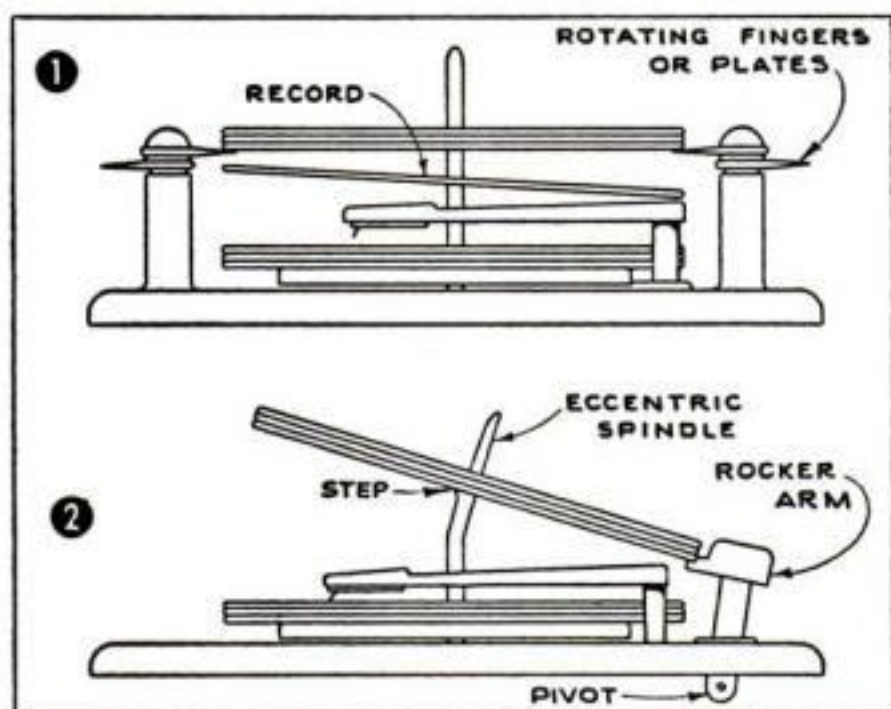
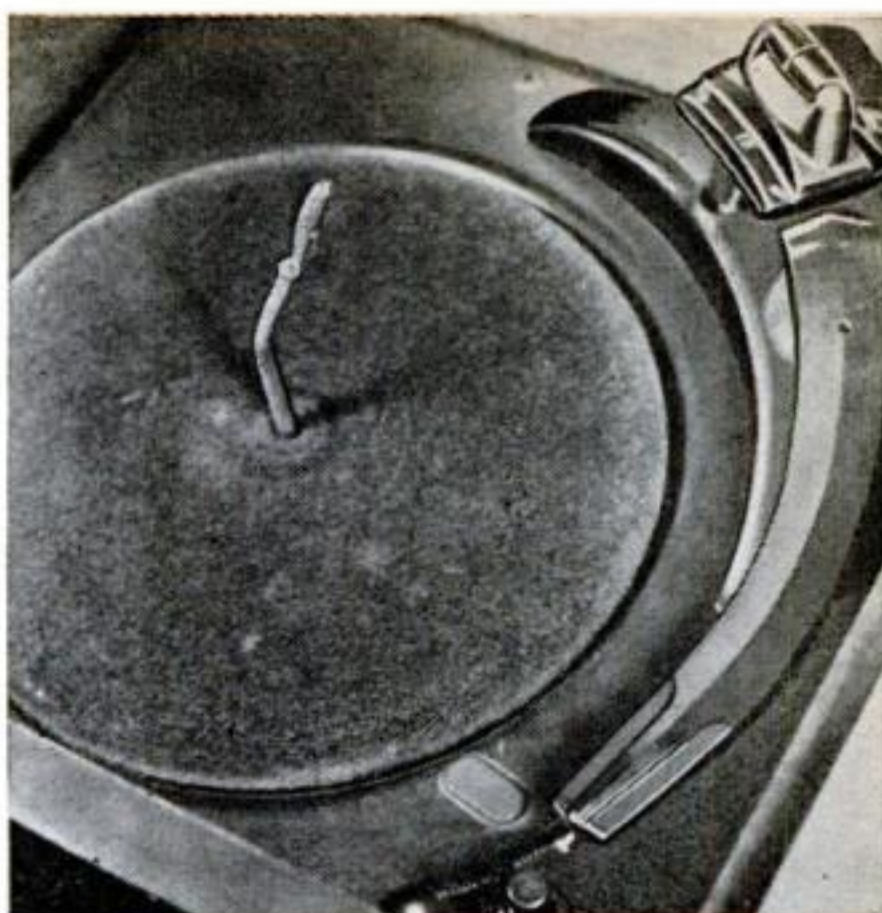
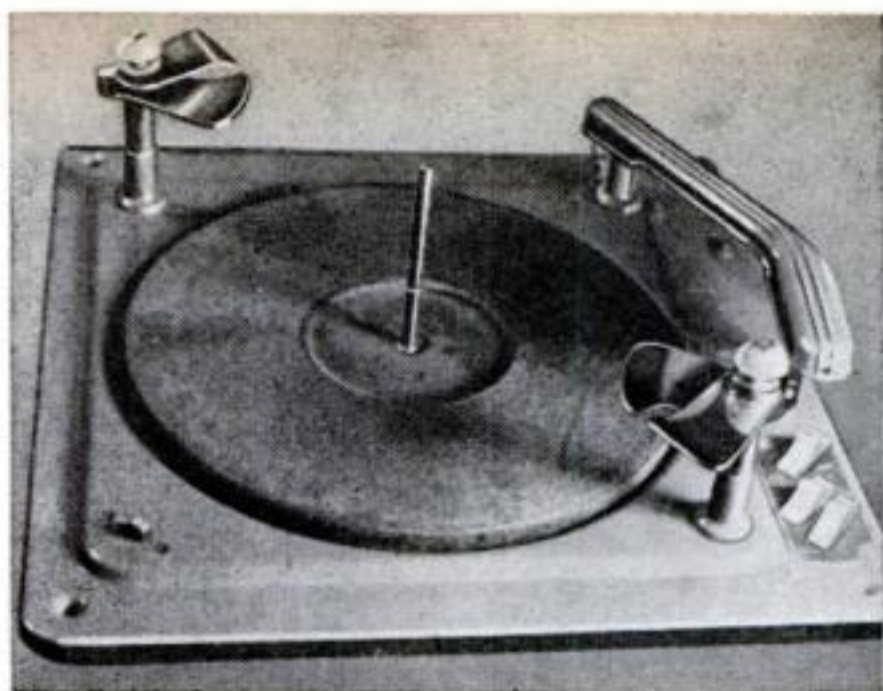
Back in the remote twenties when electric phonographs began to replace player pianos as a favorite source of canned music, the joy of having a turntable you didn't have to crank was enough to make even the laziest of us forget that switching records after each playing was an awful lot of work. Then the early record changers made their appearance. With plenty of reason they came to be known as "platter busters." Action was the one thing they had plenty of, but records rarely had better than a 50-50 chance of survival when they went through the clanking mill.

Breakage has continued to be a problem in the mechanical handling of relatively fragile records, but in general it is no longer a serious consideration. Automatic changers now in production have proven themselves quite gentle. Curiously enough, the low-priced units are almost foolproof, while the more expensive jobs still give a small amount of trouble because they have more moving parts to get

out of adjustment.

Record changers are most commonly found in radio-phonograph combinations, but they can also be purchased separately and connected to any radio set. All of the inexpensive and some of the higher priced models operate on one or both of the two principles illustrated in Figs. 1 and 2, and in the accompanying photos. The first of these employs rotating fingers or plates to suspend the stacked records over the turntable. When the changing mechanism is set in motion, the plates swivel around, releasing the lowest record in the stack and permitting that one to drop while the others stay suspended.

Equally popular is the eccentric-spindle type. The records waiting to be played are



The two principles on which most changers operate are illustrated in the diagrams and photos at left and above. In one form or another they turn up in practically all automatic disk handlers.

damage the fragile records than the first.

With various modifications and combinations, these principles keep reappearing in practically all except the highest-priced record changers. Below at right is a unit that employs the eccentric spindle and rocker arm plus two supporting fingers; alongside it is a model that is more conventional in appearance but boasts the additional feature of playing an intermixed stack of 10" or 12" records. One of the most elaborate and distinctive outfits is illustrated on the following page.

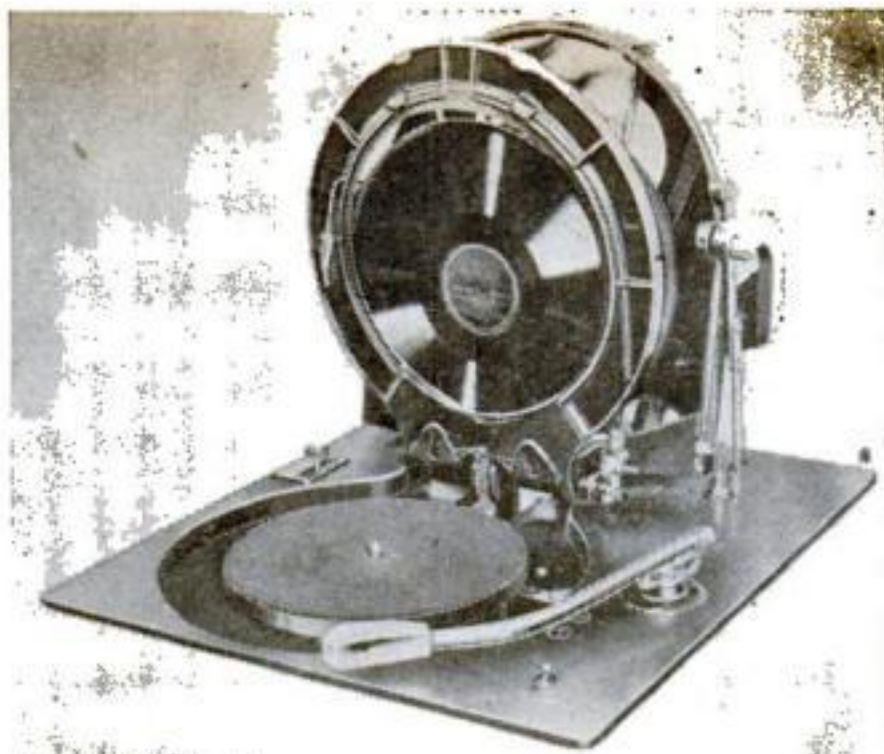
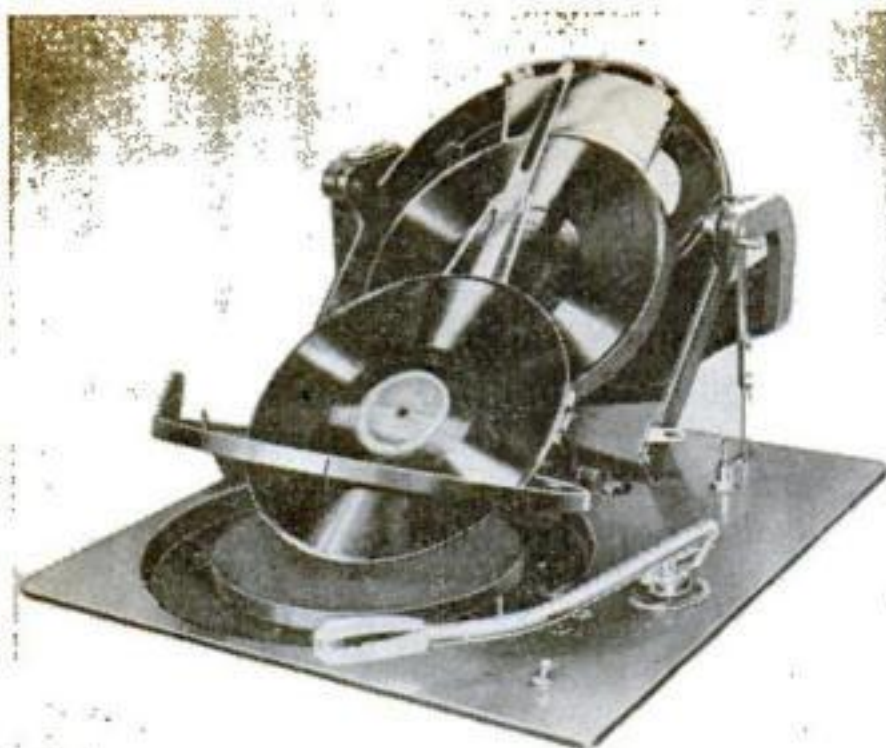
In all types, the change mechanism is triggered by the relatively broad swing of the pickup arm when it engages the run-out spiral at the center of the record. The pickup

balanced on an inclined, off-center portion of the spindle. A rocker arm at the side of the turntable supports most of the weight of the disks, and when the change cycle is in full swing acts to push the bottom record from the curved to the straight portion of the spindle, from where it can fall to the playing surface. Other things (such as precision of machining) being equal, the second type of changer is less disposed to chip or



The Webster 70, left, uses the eccentric-spindle principle, but plays a mixed stack of 10" and 12" records. Below, rotating fingers and an inclined spindle are combined in the Farnsworth P-50.





Unique in its field, and more costly than the other changers described, the Capehart, above, will play the first side of successive records to the end of the stack, then turn them all over automatically. In addition, it will turn over individual records, playing first one side, then the next, then change disks.

arm is withdrawn to the side while the new disk drops to the turntable; then the pickup swings back to the first groove and the playing cycle starts afresh.

If you're in the market for a player, bear in mind that pickups are a commodity that must never be bought by the pound. Needle pressure on the better changers is generally 1 oz. or less, and the lightweight pickups are highly desirable from the standpoint of tonal quality as well as for minimum needle scratch and record wear. A permanent or semipermanent needle is, of course, necessary with all changers; there would be little point in saving you the trouble of changing records if you had to change needles after each playing. Semipermanent needles are good for a dozen or more plays, while the permanent variety may be used thousands of times. Once a needle is used, it should never be touched until it is to be removed, since the needle quickly wears down to the shape of the grooves, and even the most minute displacement will cause its sharp edges to cut and scour the sound track.

A cabinet of some sort should be provided for the changer. It is usually most convenient when used in combination with its radio amplifier, but if the radio is too small, or the box cannot be adequately soundproofed, a separate cabinet can be made or purchased for the purpose. A template for cutting the mounting panel is provided by the manufacturer of the changer in most cases. If the unit is intended to be mounted on spring supports, adjusting these so that the changer is free to move slightly will tend to discourage operating noises and

electromechanical feedback known as "howls."

One annoying characteristic of crystal pickups is "needle chatter," a mechanical noise produced by the needle itself, particularly at high frequencies. When volume is low, the chatter may mask the sound coming from the loudspeaker, causing the set to sound tinny. Soundproofing the cabinet by lining it completely with a soft, absorbent material such as acoustic felt should remedy the situation. Another way is to place the changer in an adjoining room, away from the speaker.

This type of noise should not be confused with needle scratch, which is characteristic of records worn by repeated playings and cannot be eliminated except by means of a high-frequency cutoff filter. Unfortunately, the filter also results in a loss of tonal brilliance.

Connecting a separate record changer to a radio is usually a simple operation. Where phono jacks are built into the set's chassis, the problem is solved; where no connection is provided for, the center lead of the pickup cable can be soldered to the "hot" side of the volume control and the shield grounded to the chassis (Fig. 3). To differentiate the volume-control terminals, remove the set from its cabinet and, while it is playing at full volume, touch each of the stator terminals of the control with a screwdriver. Touching the hot terminal will cause a hum in the speaker.

A single-pole double-throw toggle switch installed on some accessible portion of the chassis allows the amplifier to be turned from radio to phonograph operation. Where



Adjusting the pickup so that the needle will engage the first groove of the record. The position of the screw varies on different models.

the pickup cable is not long enough to reach the radio, an extra length of shielded wire may be spliced on and the braid of the two pieces securely bonded together.

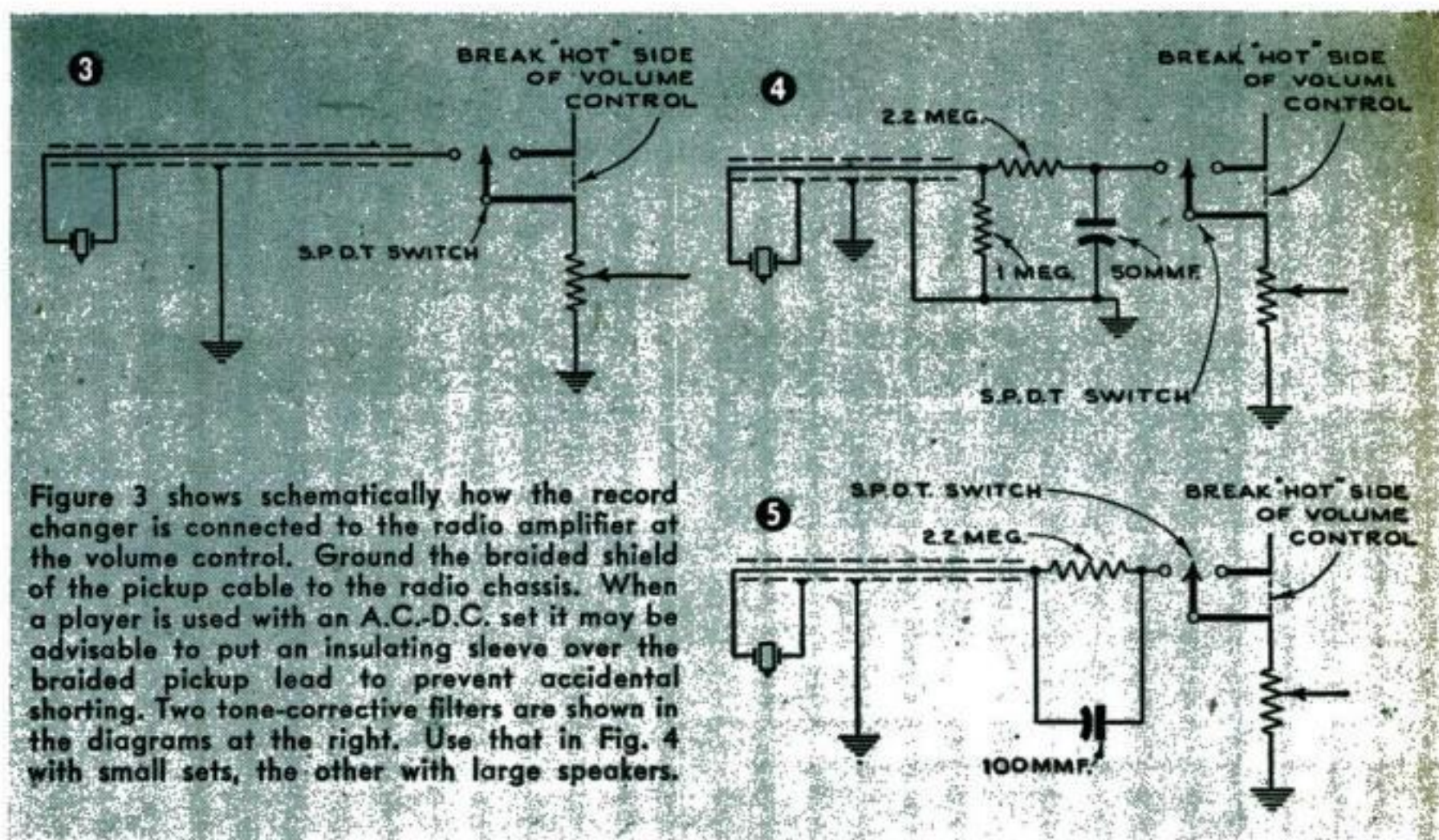
Sets of the A.C.-D.C. type should never be grounded externally, since one side of the A.C. line is already grounded to the chassis, and a short circuit would result from plugging the set in with incorrect polarity. Lead wires for the motor should be spaced as far as possible from the braided cable to minimize hum pickup.

Since the output of crystal pickups is not uniform at all frequencies, and since different processes are employed for cutting rec-

ords, some type of compensating circuit is usually considered desirable on phonograph amplifiers. Two such equalizers are shown in Figs. 4 and 5. Placed between the pickup and the amplifier, the filter shown in Fig. 4 will give a moderate amount of bass boosting and high-frequency attenuation; it is recommended for table model sets having 5" or 6" speakers. Treble boosting is accomplished by the circuit in Fig. 5, and is best for a console with an 8", 10" or 12" speaker and a fairly good audio system. Larger and more elaborate consoles usually have built-in tone controls which permit additional equalization.

Properly handled, modern record changers give surprisingly little trouble. Jamming is often caused by warped or off-size records, and failure of the change mechanism to operate is probably due to use of old-style records on which the run-out groove has not been carried far enough over the disk. Sometimes the pickup fails to drop neatly into starting position, but this can be corrected on most changers. The photo at the upper left shows one type being set for proper operation by means of an adjusting screw located near the pickup pivot. On other models the screw is found behind or underneath the pickup arm.

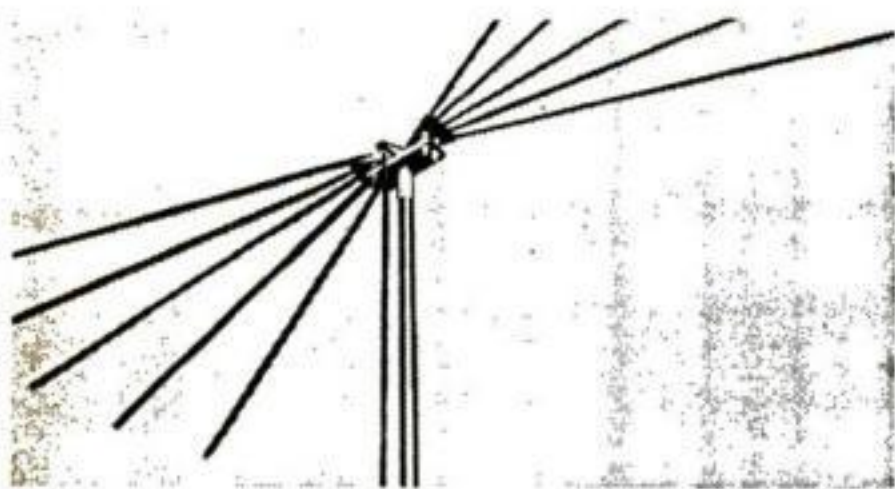
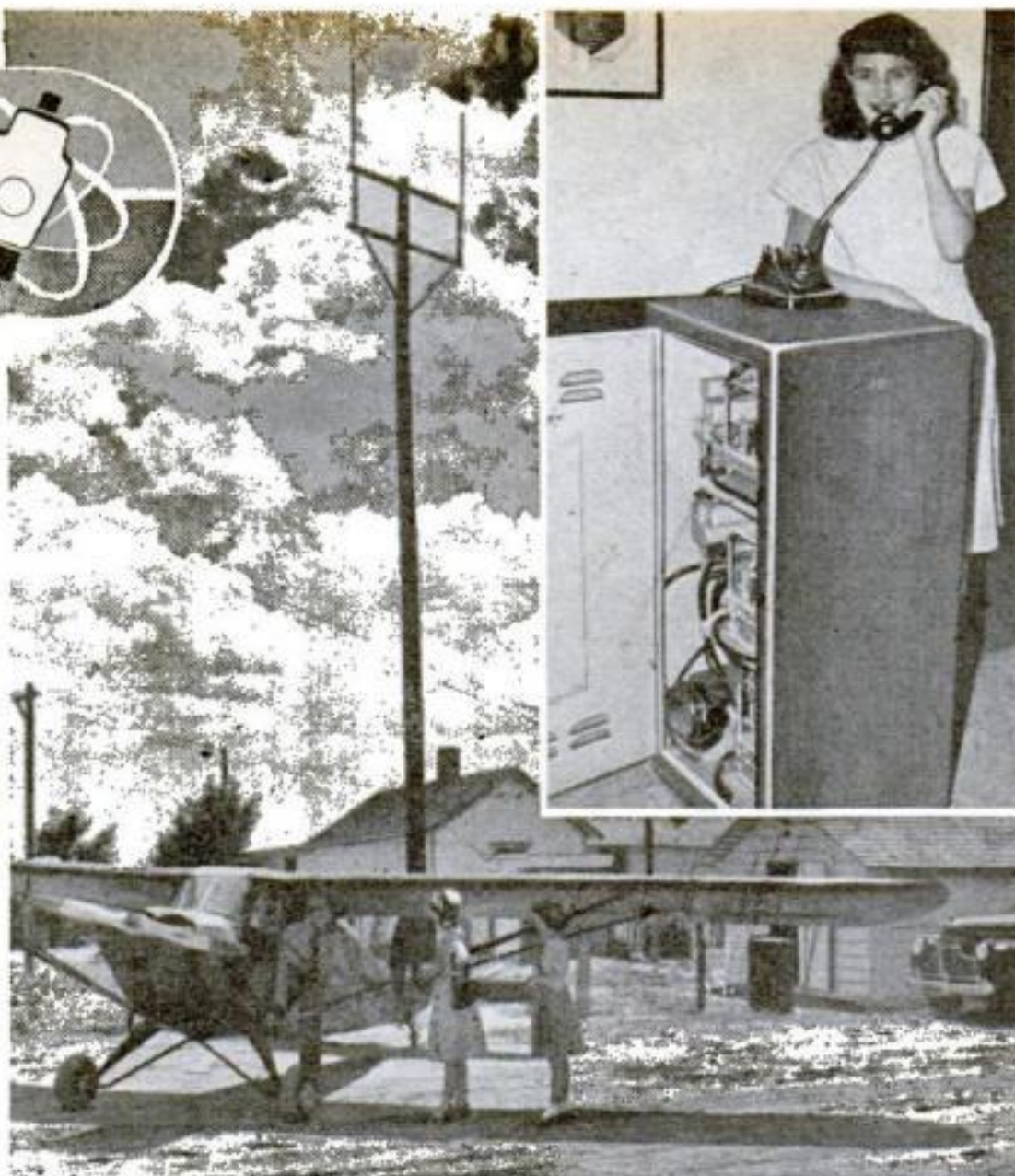
All in all, most of the current crop of record changers will deliver years of trouble-free, pleasurable service. If you like recorded music, you can hardly find a better investment.



NEWS IN ELECTRONICS



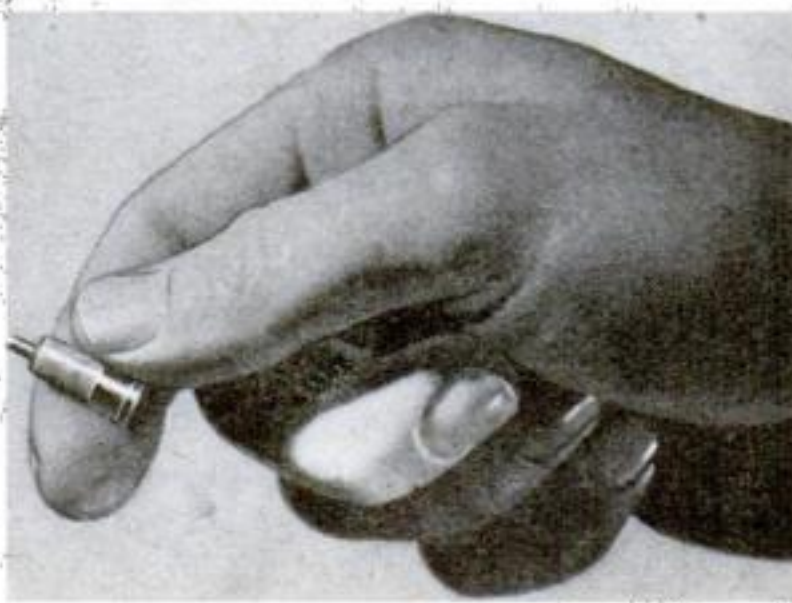
DISTANCE is no obstacle to communication on this remote Colorado ranch. Eight ranch houses in the eastern part of the State have been connected by two-way radio with the Cheyenne Wells, Colo., exchange of the Mountain States Telephone Co., from where they can be linked with any phone in the country. Still in the experimental stage, this development is expected to bring service to places where regular wire lines are impractical because of distance. This antenna is 21 miles from the central office.



RECEPTION ON ALL CHANNELS in the F.M. and television bands is promised for this antenna, manufactured by the Andrew Co., of Chicago. Called the "Di-Fan," the unit consists of a fanlike array of five elements extended in two directions; its impedance is matched to that of the lead-in lines. It is sold with brackets for mounting it to chimney or roof.

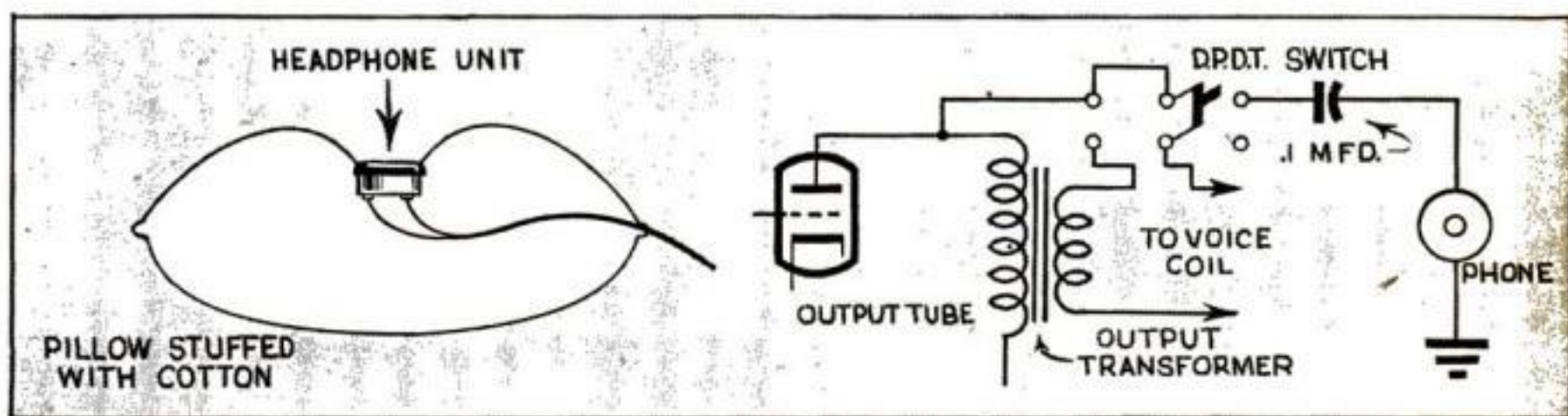
SILICON CRYSTAL CONVERTERS, developed for radar receivers, are now available through civilian distribution channels. As space-saving first detectors in superheterodyne circuits, the permanent, preselected crystals are capable of handling frequencies up to 10,000 mc. The model at the right is offered by the Sylvania Electric Products Co.

A PHONOGRAPH PICKUP employing the principle of torsional magnetostriction has been announced by the Magnetostriction Devices Co., of Boston. The effect of magnetism on the size or shape of an object is said to have made possible a light-pressure, low-cost pickup with uniform response and relative freedom from harmonic distortion as well as from "needle chatter" and hum pickup.



Pillow Phone Mutes Late Music

IF YOU like to let that last musical night-cap rock you off to sleep like one of mother's lullabies, try this way of doing your mid-night listening. It's as comfortable for you as it is for the other members of the family who have already succumbed to the sand-man. A suitable pillow can be made with tightly packed cotton. Wire any good-quality headphone to the output of your radio as shown, and stitch the phone into a depression formed in the pillow. When used with large consoles, the headphone should come off the second detector instead of the last audio stage.—W. E. DANNEMAN.



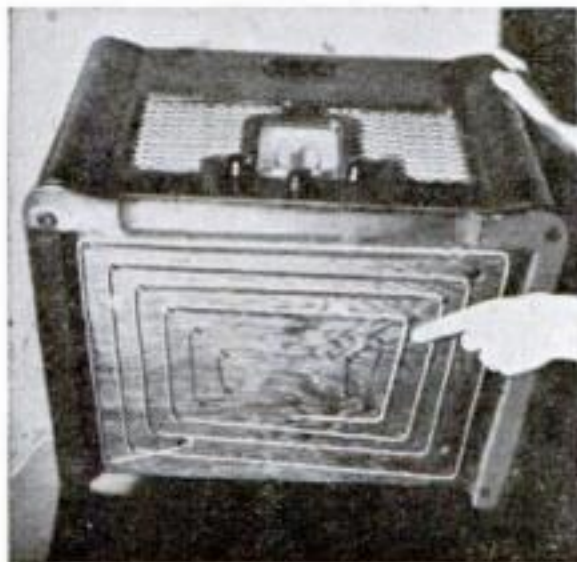
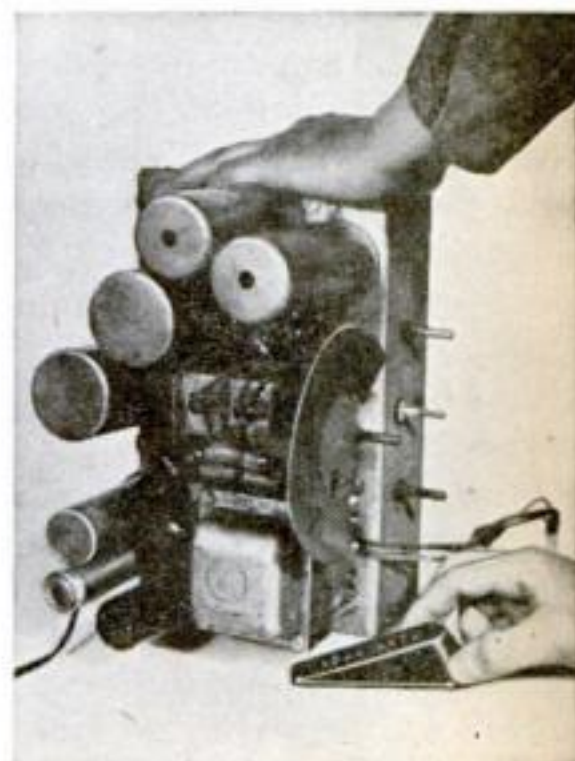
Reinforcements Stop Record Slipping



STACKED phonograph records sometimes skid over the records underneath, resulting in musical distortion. One frequently effective method of preventing this slippage consists of gumming three or four loose-leaf reinforcements on each record to increase the friction between the disks.—G.O.S.

Doorstop Pegs Radio

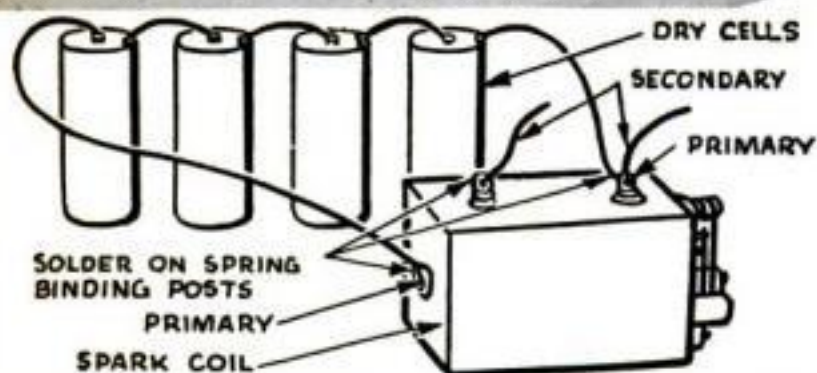
WHEN you stand a radio on end for servicing, slip a wedge-shaped doorstop under some solid part to keep the weight of the set off tubes and coils and prevent the chassis from tipping. Flexible stops of the type illustrated below can be purchased at hardware, novelty or dime stores.—H. LEEPER.



Concealed Antenna

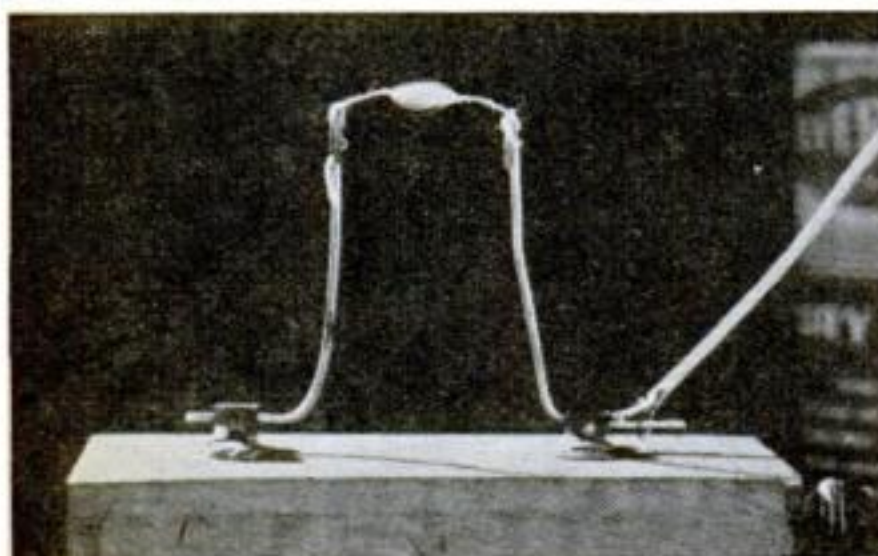
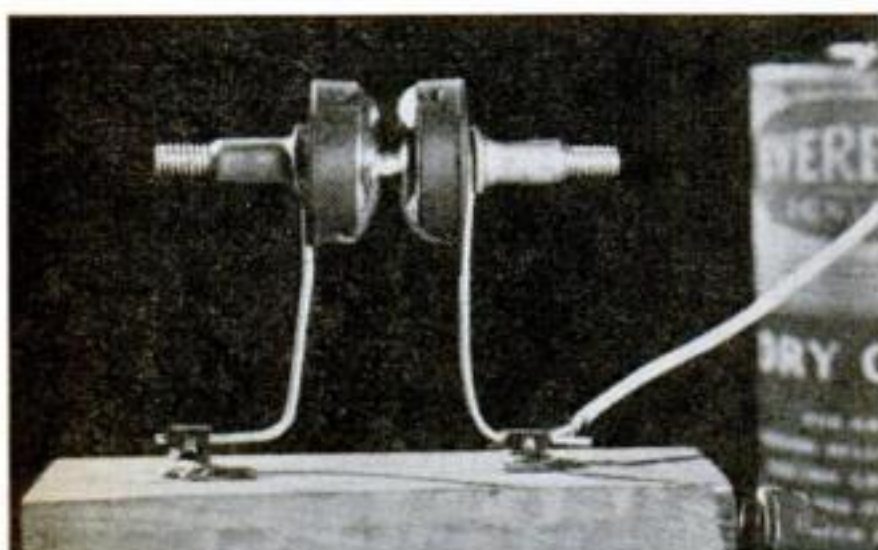
SHORT antennas need not consist of wires dangled out the window or bunched up behind the furniture. Screws driven into the bottom of the radio cabinet diagonally from each corner make convenient pegs for antenna wire as shown at the left.—ROBERT H. DALTON.

HOME EXPERIMENTS



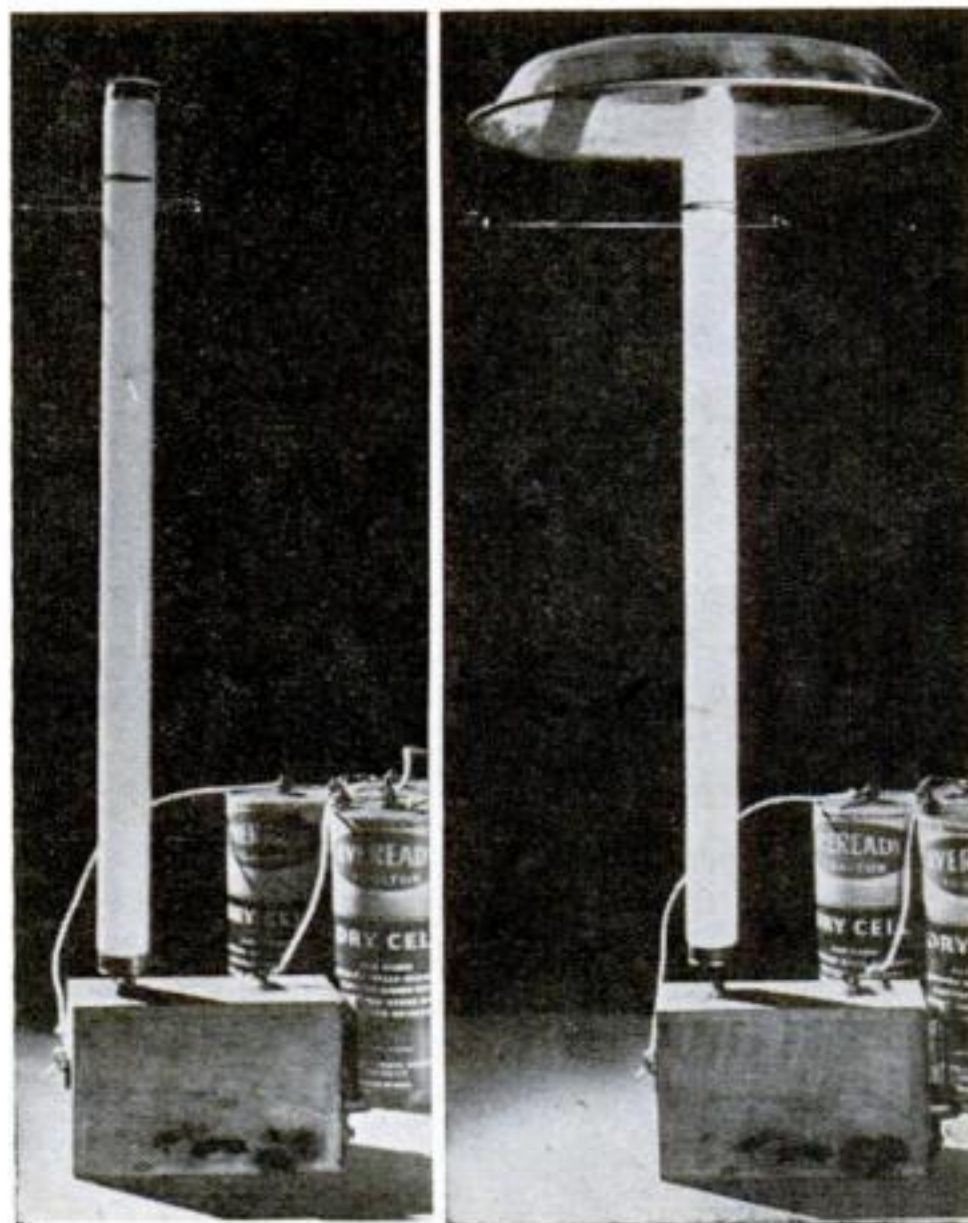
FOUR DRY CELLS connected in series with a spark coil of the type used in the Model T Ford will enable you to perform the experiments on these pages. For convenience, solder a spring-type binding post to each of the three terminals of the coil. As shown at left, one lead of both the primary and secondary goes to the side terminal near the vibrator end.

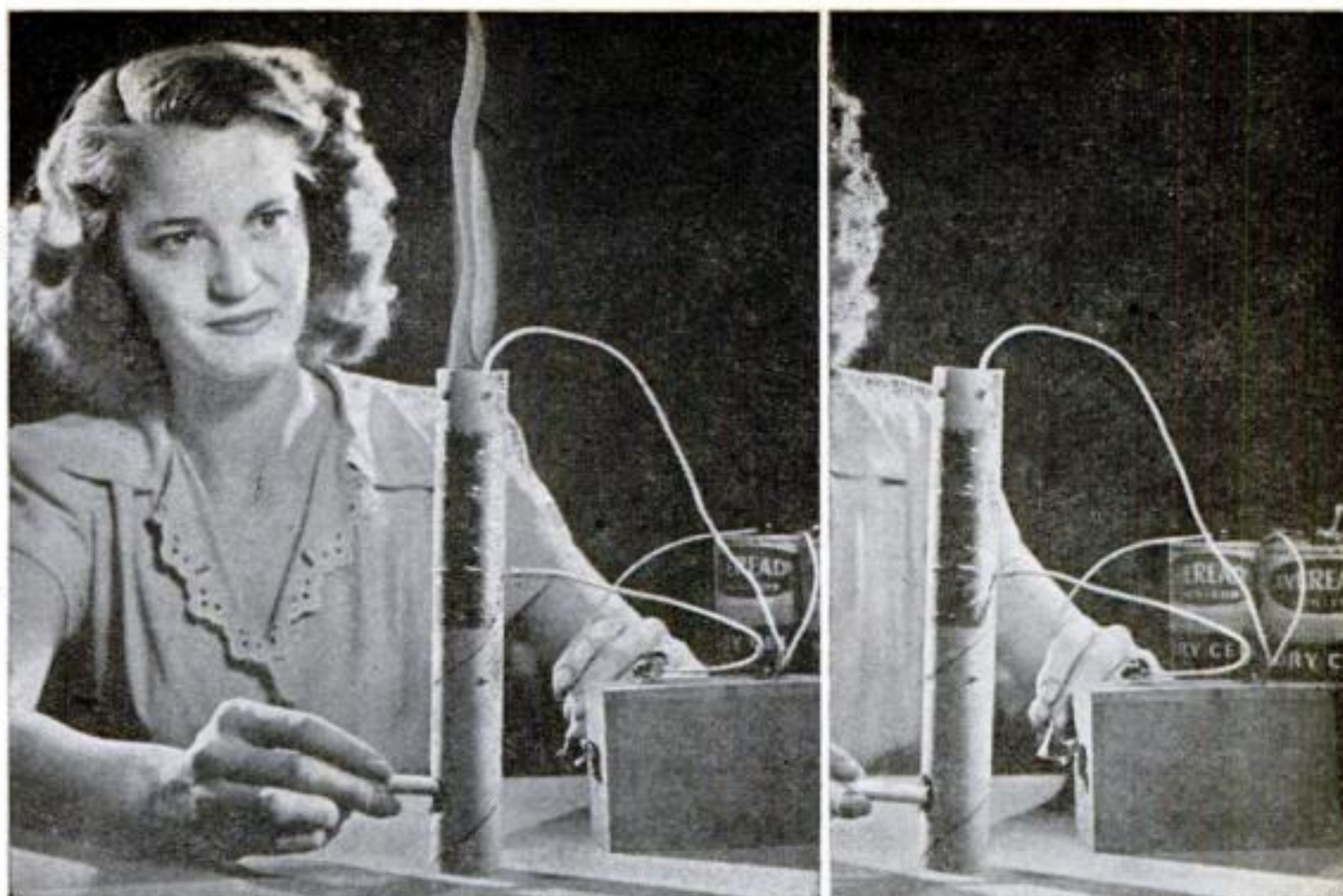
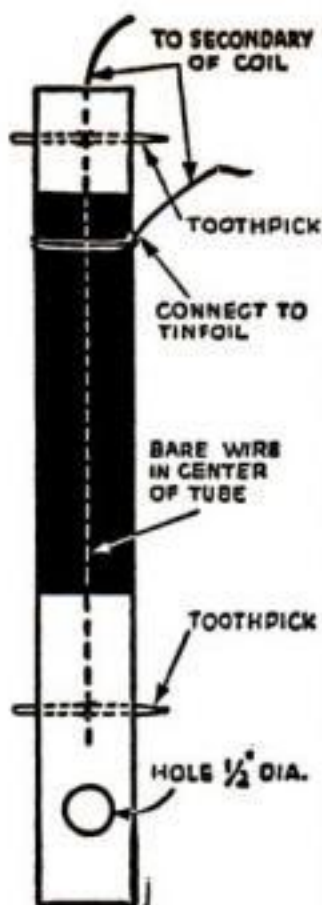
High-Voltage Fun with a Spark Coil



ELECTRIC LIGHTS normally require a closed, or complete, circuit. Yet stand a fluorescent tube on the lone secondary terminal of your coil, supporting it with insulating material; close the primary circuit, and the tube lights dimly—even though the secondary is “open”. Balance a pie pan on the tube, and it lights still more strongly. Why? In the first case, the charge in the air about the secondary excites the gas in the tube. In the second, the pan intensifies the electrical flow by acting as the plate of a condenser, accumulating a larger charge than the terminal of the tube alone.

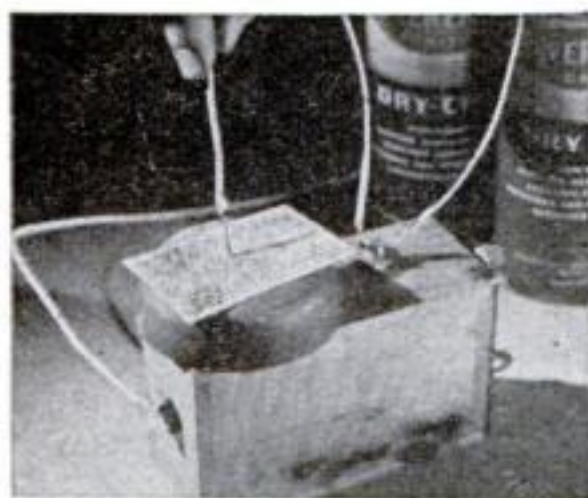
PRODUCTION OF SPARKS is the function of a spark coil. It can do this because, although the input potential is only a few volts, the output of the secondary may be from 10,000 to 15,000 volts, this high voltage permitting the secondary current to jump at least $\frac{1}{2}$ ". The spark length, however, depends on the terminals, as you can show. First improvise a spark gap with sharp points, drawing them apart (with the current off!) until you get the longest possible spark. Substitute metal silence domes for furniture (as above), and the spark will jump only a fraction as far. The reason? In the case of the points, the charge is concentrated right at these points. When the surface is large, the pressure density is less.





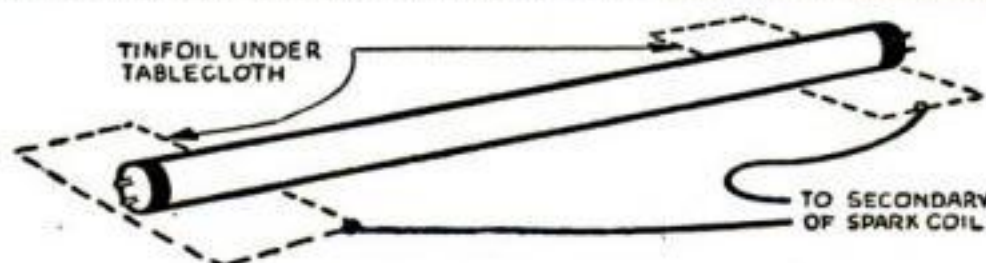
SMOKE IS REDUCED in many cities through use of Cottrell precipitators in industrial plants. The diagram above indicates how you can rig up a working model of such a precipitator with a mailing tube and a piece of tin foil. When the setup is ready, thrust a lighted cigarette or incense stick into the

hole in the tube. Smoke will pour from the top. Connect the primary circuit of your spark coil, as at the right, and the smoke will stop. Although nothing visible happens within the tube, the high-voltage electrical field set up inside causes the smoke particles to clump together and fall to the bottom.

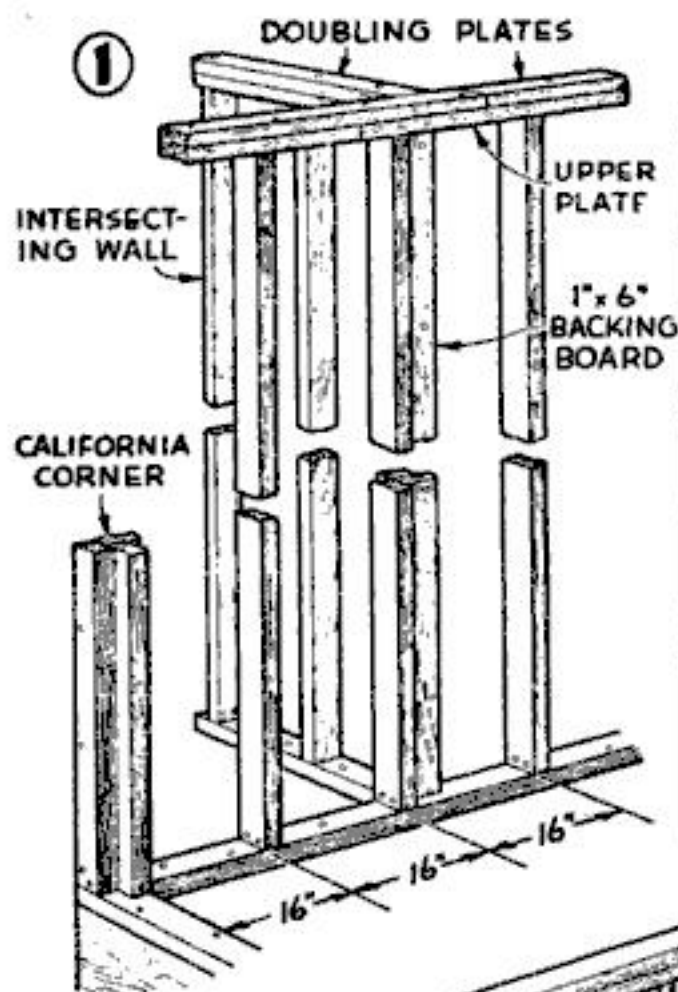


PRACTICAL JOKERS might try this idea. Over the single secondary terminal of the spark coil invert a metal ash tray with tin foil underneath to make an electrical connection. Place a cigarette paper on the tray and, with the current on, move a wire from the other secondary terminal back and forth above the paper, not quite touching it. Invisible sparks will perforate the paper with hundreds of microscopic holes. Try to smoke a cigarette made of it. You'll find it impossible.

HERE'S A TRICK to mystify your friends. Place a fluorescent tube on a table covered with a cloth. At your command, the tube will light or go out—as often as you wish. Before your performance, however, set the stage by placing two strips of tin foil under the cloth and connecting them to the secondary terminals of your spark coil, concealed under the table. Operate the coil with a concealed push-button switch. The tube must be placed with the terminals over the tin foil as shown in the drawing below.



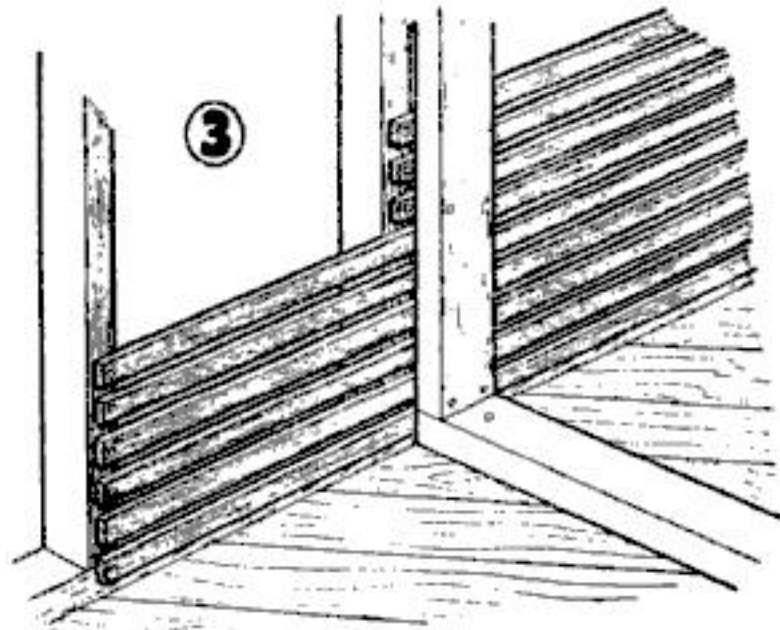
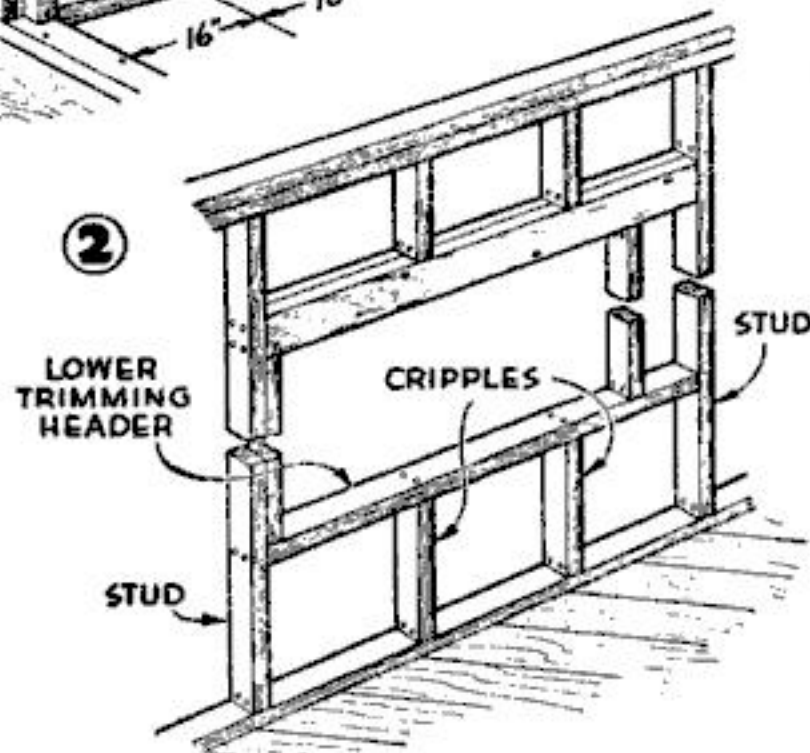
What's Wrong?



EIGHT errors in framing walls are shown in these drawings—six in Fig. 1 and one each in the other two. Answers are given below.

1. Splice the upper plate on a stud.
2. The doubling-plate splice should be at least 4' from that for a secure tie.
3. Intersecting doubling plates should lap on the upper plate of the upper plate.
4. A regular stud is needed on both sides of the intersecting wall. The 1" backing stock will cause plaster cracks at the corner.
5. Rotate the California stud counterclockwise 90 deg. to get backing studs on both sides of the inside corner.
6. Lay out studs on centers with the third 4' from the corner to avoid cutting lath.
7. Cripples are needed also under both ends of the lower trimming header.
8. Don't extend lath beyond partitions.

ANSWERS



GRADES OF LUMBER

Under the American lumber standards established by the National Bureau of Standards, yard lumber is divided into the following grades:

Select—Lumber of good appearance and finishing qualities.

Grade A—Practically clear. Suitable for natural finishes.

Grade B—Of high quality, generally clear. Suitable also for taking natural finishes.

Grade C—Adapted to high quality paint finishes.

Grade D—Between higher-finishing grades and common grades, and partaking somewhat of the nature of both. Suitable for paint finishes.

This is the lowest grade listed for use where finishing is required.

[WOODWORKING]

Common—Lumber not of finishing quality, but suitable for general utility and construction purposes.

No. 1—Sound and tight knotted. May be considered watertight. Suitable for use without waste.

No. 2—Less restricted in quality than No. 1, but of the same general character. Also suitable for use without waste.

No. 3—Prevailing grade characteristics lower than in No. 2. Some waste.

No. 4—Low quality. Some waste.

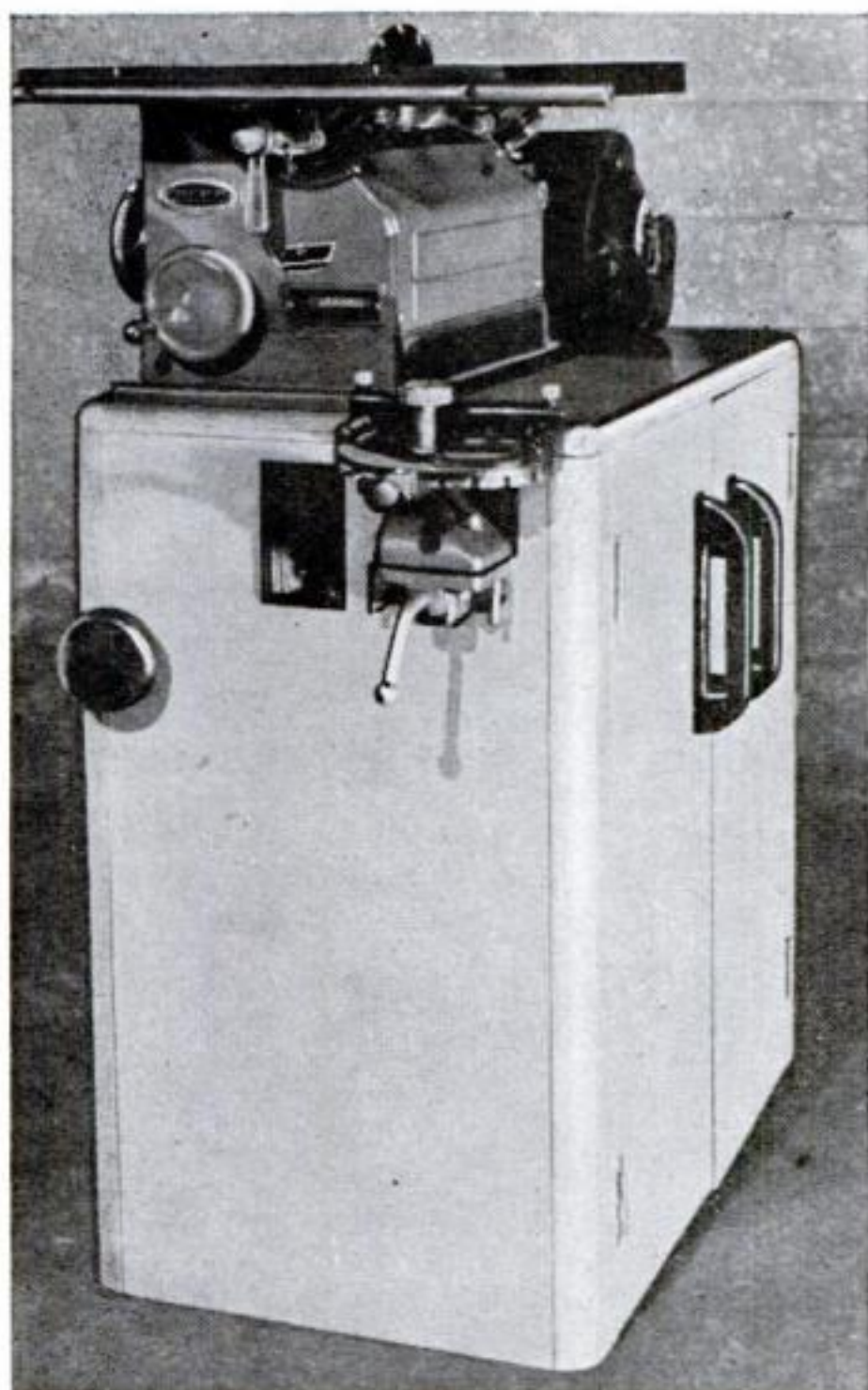
No. 5—Lowest recognized grade, but must be usable. Some waste.

Except in the dimension and timber classifications, the grade of yard lumber, rough or surfaced two sides, is determined from the better or face side. Lumber surfaced one side only is graded from the surfaced side.

POPULAR SCIENCE MONTHLY SHOP DATA

Circular-Saw Bench

HAS KNEE-OPERATED SAFETY SWITCH

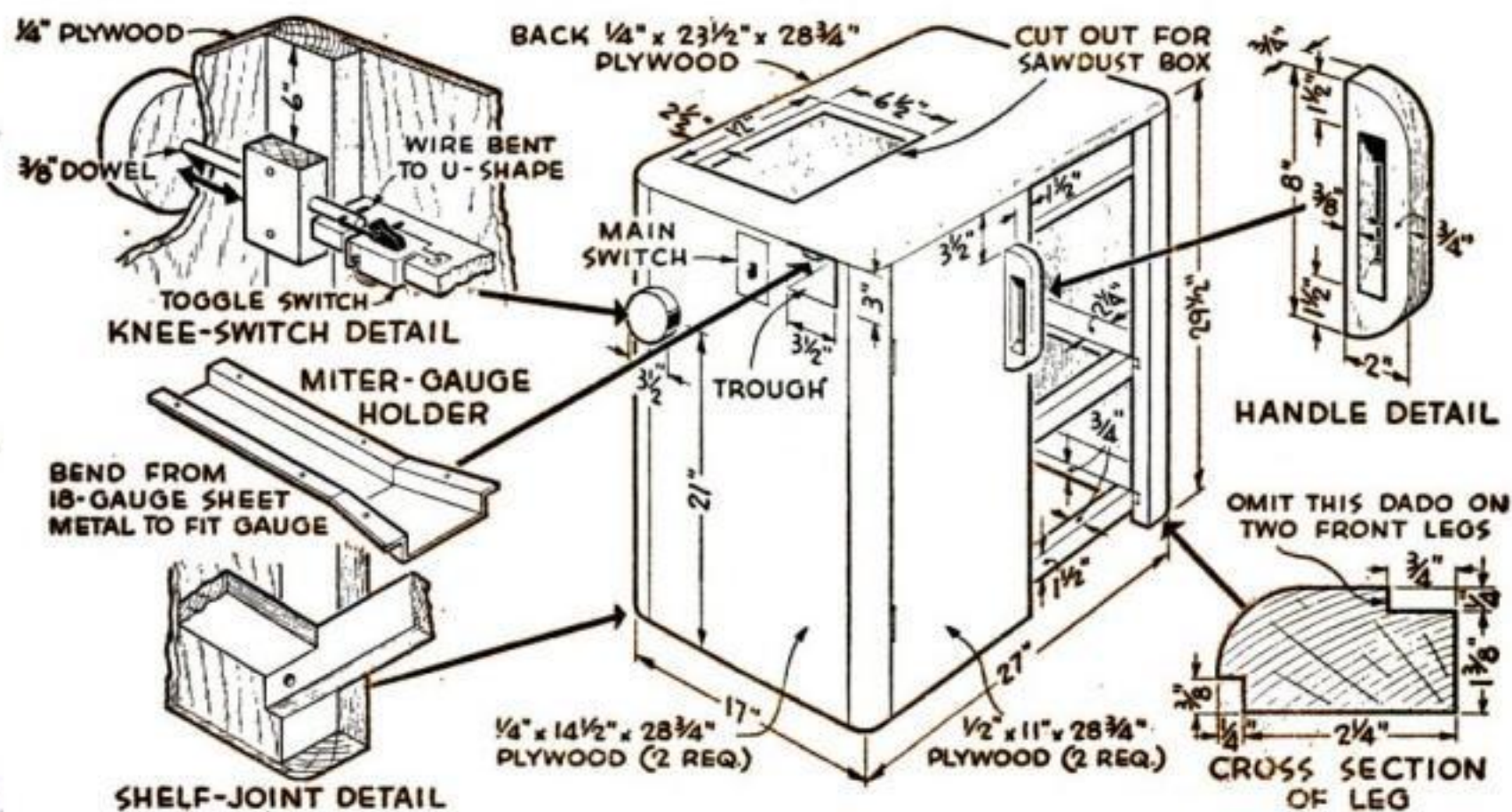


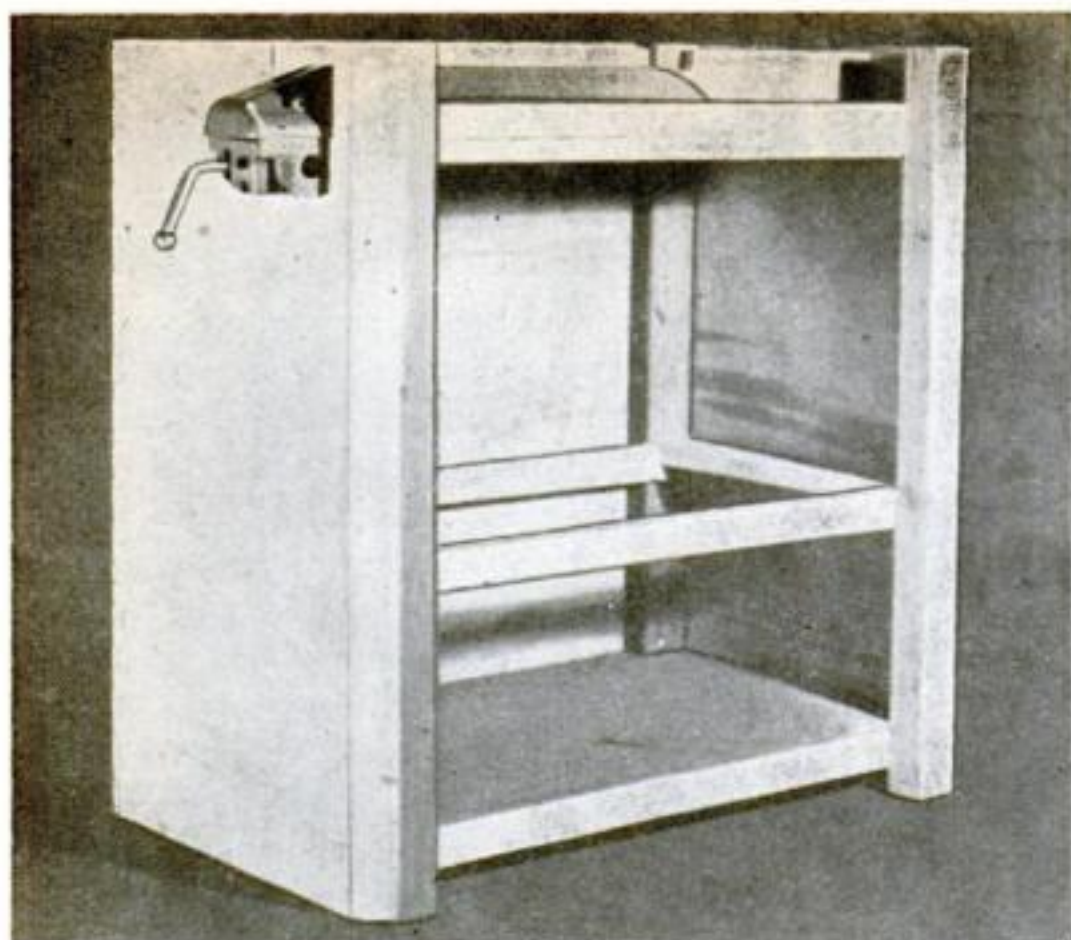
BASIC features for both safety and efficiency are incorporated in the design of this home-built bench for a circular saw. A switch, operated by pressure from one knee, will cut off the motor in an emergency when both hands are occupied, and the starting connection can be locked in the "off" position simply by the removal of a wire U. The bench also has a built-in ripping-fence rack, a miter-gauge holder, a built-in sawdust box, and generous cabinet space for holding accessories.

Both the knee switch and the hand-operated main switch on the side of the cabinet must be "on" for the saw to run. Since the former is pushed in for emergency stopping only, it must be pulled out again by hand before the saw can be started up.

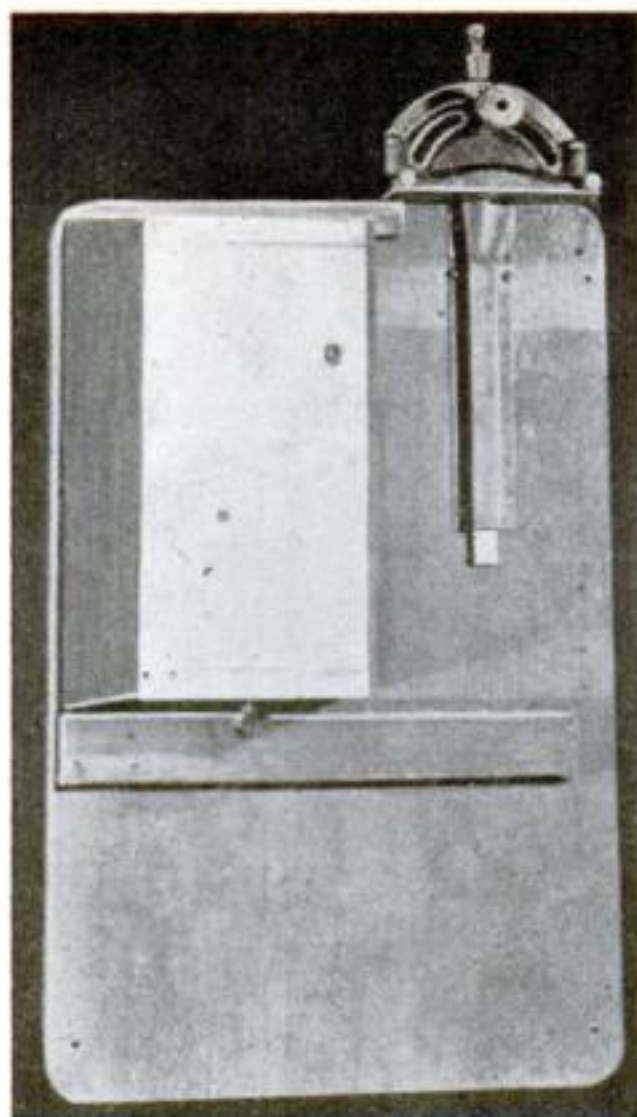
Ordinarily, if there are children about, the only precaution necessary on leaving the saw is to push the knee switch in and turn the toggle switch off, but the wire *U* connecting the knee-switch dowel to the inside switch can be pulled out as well when the knee switch is in the "off" position. Be sure to have this inside switch in such a position that it can be shut off by the knee plunger even though the *U* has been removed from the setup.

Parts can be cut on the saw itself if it is





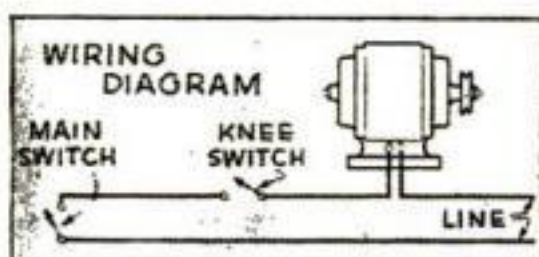
This circular-saw bench cabinet has generous storage space. At right, a view of the table top from the underside. The wiring diagram below shows switch connections.



mounted first on a temporary base. Some change in dimensions may be required to suit the saw for which the bench is intended.

The top for the table shown was salvaged from an old gas ironer and was already glued up in a piece of sufficient size. If a piece large enough cannot be found, a strong table top can be glued up.

In cutting out the handles, drop each side on the saw or dado head to put the hand hole through it. Hold the block against a stop

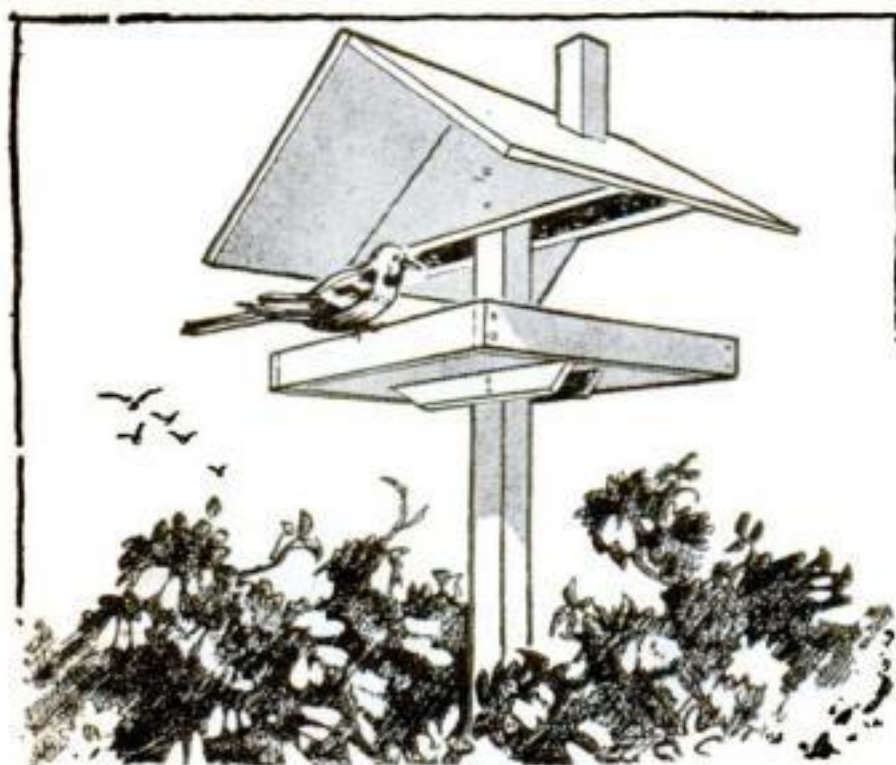


clamped to the fence, lower it on the saw, and push it ahead. Then shape the ends. Time can be saved in rounding the corners if they are first cut off at 45 deg. and

then two thinner cuts taken at about 25 deg. The sawdust box is slightly larger than its hole and is suspended by a horizontal dowel at one end and a hook and eye at the other.

Screw the miter-gauge holder to the top at the middle of the opening for the ripping fence.—R. F. KOEBBEMAN.

Covered Winter Feeder Protects Birds' Food from Weather

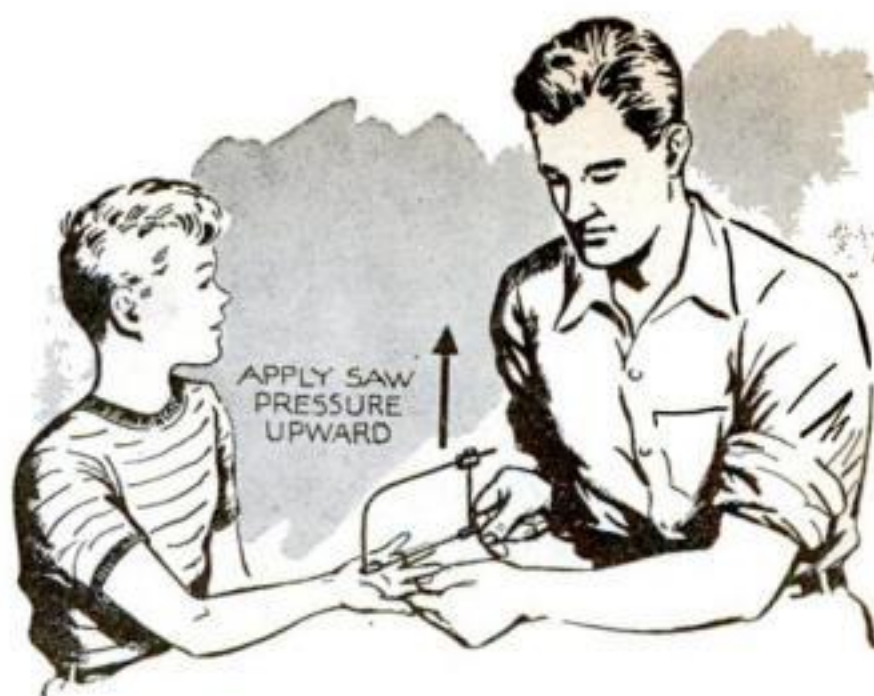


Food left out for birds in winter must be protected from rain and snow, or it will get soggy and freeze. A roof over the feeder will solve the problem, though it may cause the birds to be a little timid at first. If you place the feeder on a post about 15' above the ground, however, the birds will eventually learn to disregard the roof, and your yard will become a gathering place for them all through the winter.

Except for the 2" by 2" upright, which should be a good 18' length, all wood can be scrap or pieces from discarded crates. The outside of the feeder may be painted, but the birds will feel more at home if the inside is unpainted.—R. H. DIRCKS.

Sawing Off a Tight Ring Safely

IF COLD soapy water has failed to remove a tight finger ring, the following method will be found faster and safer than filing it off. Insert a jeweler's saw blade under the narrowest part with the teeth up. Clamp it in the saw frame and saw upward, away from the finger. Soap may be used as a lubricant. Saw slowly to avoid heating the blade by friction. Once cut through, the ring is easily spread a trifle and slipped off.—C. R. SCHLEGEL.

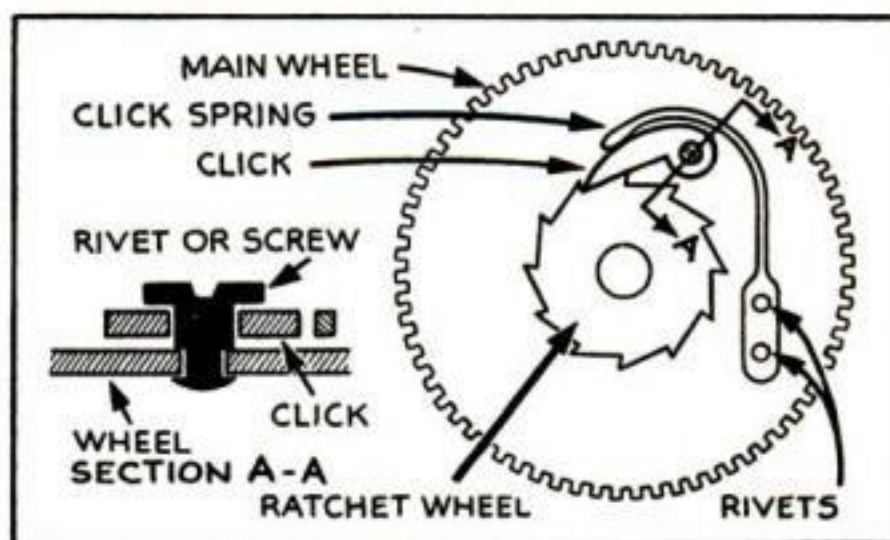


How to Repair a Clock When Mainspring Won't Stay Wound

A COMMON source of trouble in alarm clocks is a defective click (ratchet pawl) or click spring. When either fails, you can wind the mainspring but it unwinds immediately. To fix these parts, first take out the movement, spread the plates, and remove the main wheel, to which the click is attached, on its arbor.

Some clocks have special clicks, for which you may be able to buy a replacement. If not, use a standard one from an old clock, or make one of sheet brass about as thick as the ratchet. Because of the spacing of the spokes, you may have to devise your own way of anchoring the new parts. The click should be riveted to the wheel so that it can move freely. A shoulder rivet is

best, but a plain one will do. The shape of the spring may vary considerably, but it should hold the click firmly against the ratchet and should be anchored at two places.—WILLIAM SCHOPP.

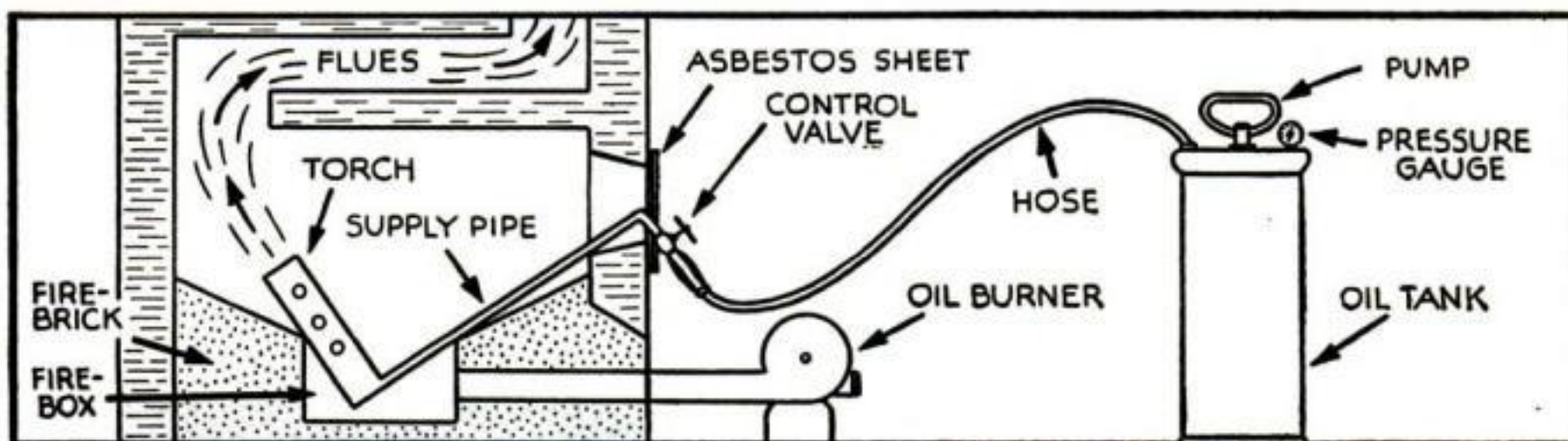


Weed-Burning Torch Heats Furnace When Oil Burner Quits

A FAILURE of either electrical power or your oil burner needn't leave the house uninhabitable if you can buy or borrow an oil-burning torch of the kind used for burning weeds. Having its own fuel tank and nozzle, it can be adapted to heat the furnace without altering the regular equipment.

Light the torch and place it in the firebox as shown below; then fit a piece of sheet

asbestos over the furnace opening, cutting a notch to admit the torch hose and a certain amount of air. The size of this notch must be determined by experiment while watching the flame. If the regular oil burner is a gun type, remove the access plate at the end of the gun housing to admit extra air. Keep tank pressure up to insure normal combustion.—W. H. JACQUES.



CHEMISTRY answers the Fire Alarm

By KENNETH M. SWEZEY

PROPERLY controlled, fire is one of the most useful chemical reactions known to man, but out of hand it is an awe-compelling agent of destruction. Despite fire-prevention campaigns and highly efficient fire-fighting equipment, it causes 40,000 casualties and damages nearly half a billion dollars worth of property each year in the United States alone. On the average, a severe fire occurs every 50 minutes.

Most big fires start small. They could be checked easily and with little resultant damage if they were caught in the beginning. Fighting any of the different types of small fires is nothing more than a simple problem in physical chemistry, but the method employed for one fire is not necessarily the best for another.

All ordinary fires are the result of rapid oxidation. For this oxidation to take place,

two conditions must be met: the substance must be heated to its kindling temperature, and there must be sufficient oxygen. Consequently, if we can reduce the temperature of the burning substance below its kindling point or cut off the supply of oxygen, the fire will stop. The two chief methods of fire extinguishing, therefore, are cooling and smothering. Whether one, the other, or both methods should be used depends upon the type of fire.

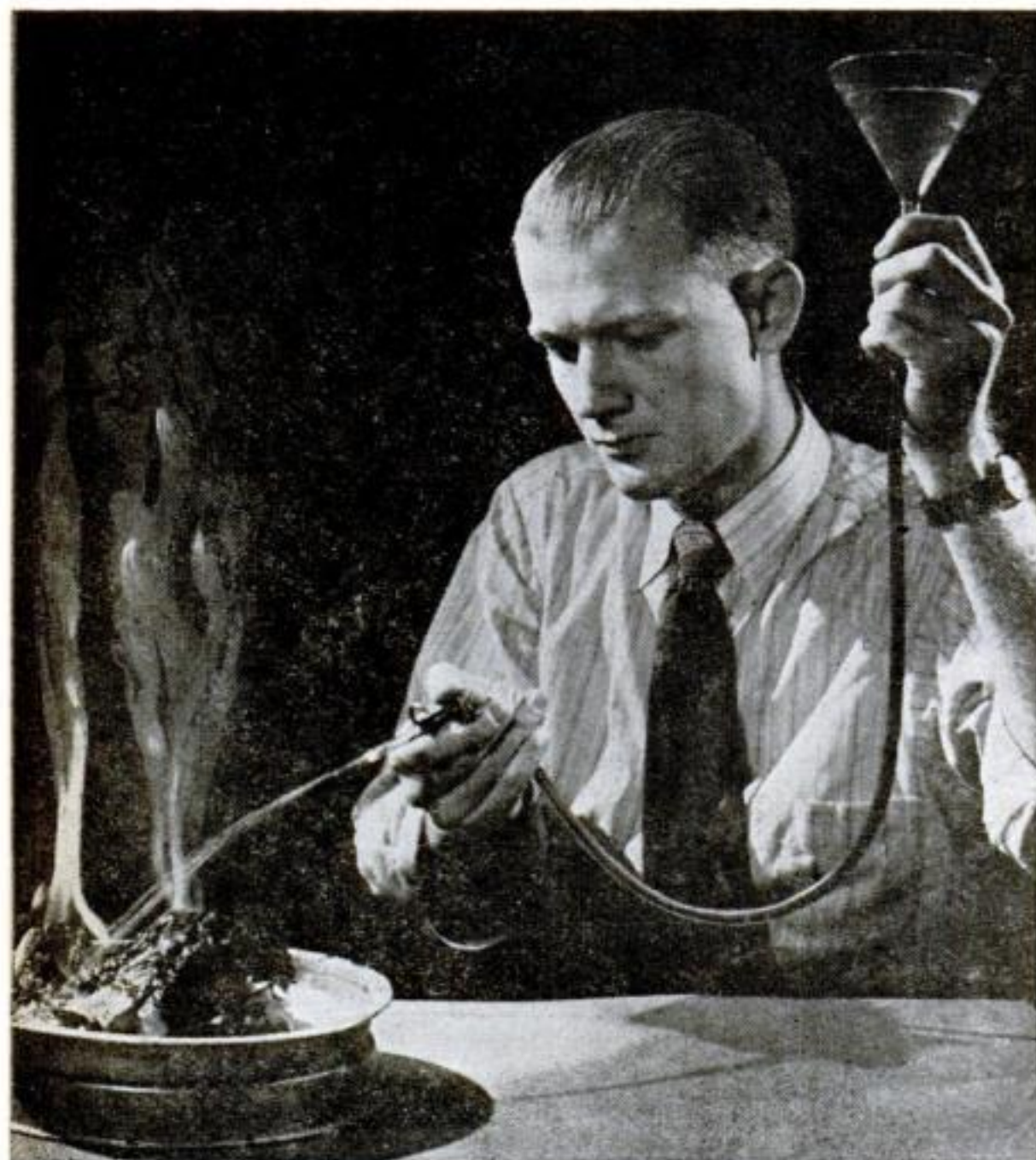
Soaking the burning material with water is the oldest method of reducing the kindling temperature. With all our modern foams, sprays, and chemical apparatus, water still is the most effective, cheapest, and most abundant medium for extinguishing large fires involving wood, paper, clothing, and

other ordinary inflammable materials. Even the common soda-acid fire extinguisher owes its effectiveness to water.

You can demonstrate this usefulness of water by rigging up an extinguishing apparatus consisting of a 2' length of rubber tubing with the stem of a funnel inserted in one end and the glass part of a medicine dropper in the other. Place a pinchcock at the nozzle end of the tubing to retain the water until needed and fill the funnel and hose with water. Pressure is obtained by elevating the funnel.

Start a small demonstration fire by igniting a wad of paper in a cake tin, which has been placed on an inverted tin to insulate

Water is the oldest method of extinguishing a fire, and still one of the best. You can prove its efficiency with the simple apparatus shown in this photo.



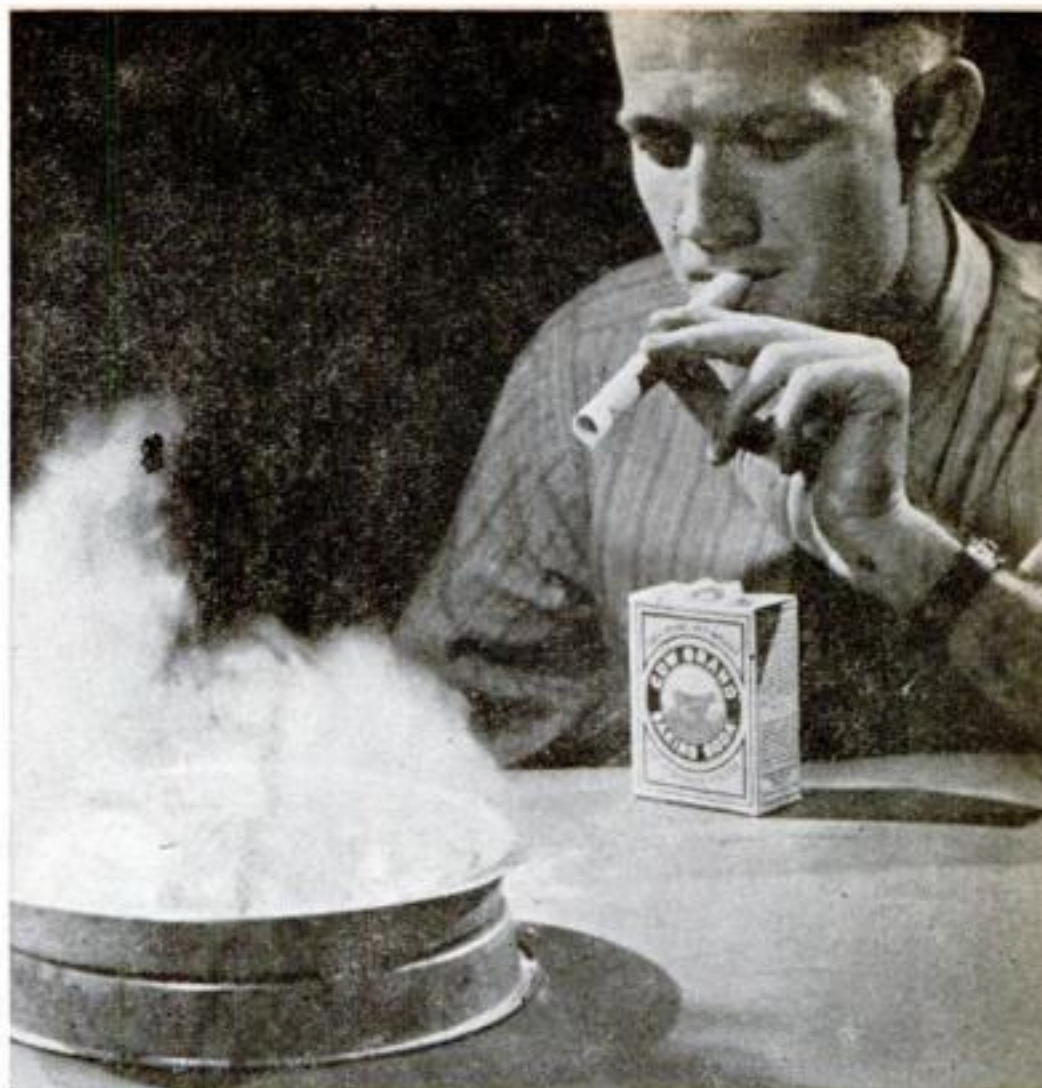


Different Fires Require Different Extinguishers

ANY good extinguisher may be used on burning wood, paper, clothing, rubbish, and ordinary inflammable materials, but water or soda and acid are the most economical.

For oil, grease, gasoline, or paint fires, use foam, carbon dioxide, methyl bromide, carbon tetrachloride, or dry chemicals; never water.

Use carbon dioxide, methyl bromide, carbon tetrachloride, or dry chemicals for live electrical wiring that is afire. Never use any water, foam, or soda and acid.



If blown as dust, bicarbonate of soda will put out a fire.

the table from the heat. When the fire has begun to blaze strongly, play water over the burning material. By maneuvering the stream, you will see how little water is needed to put out the fire.

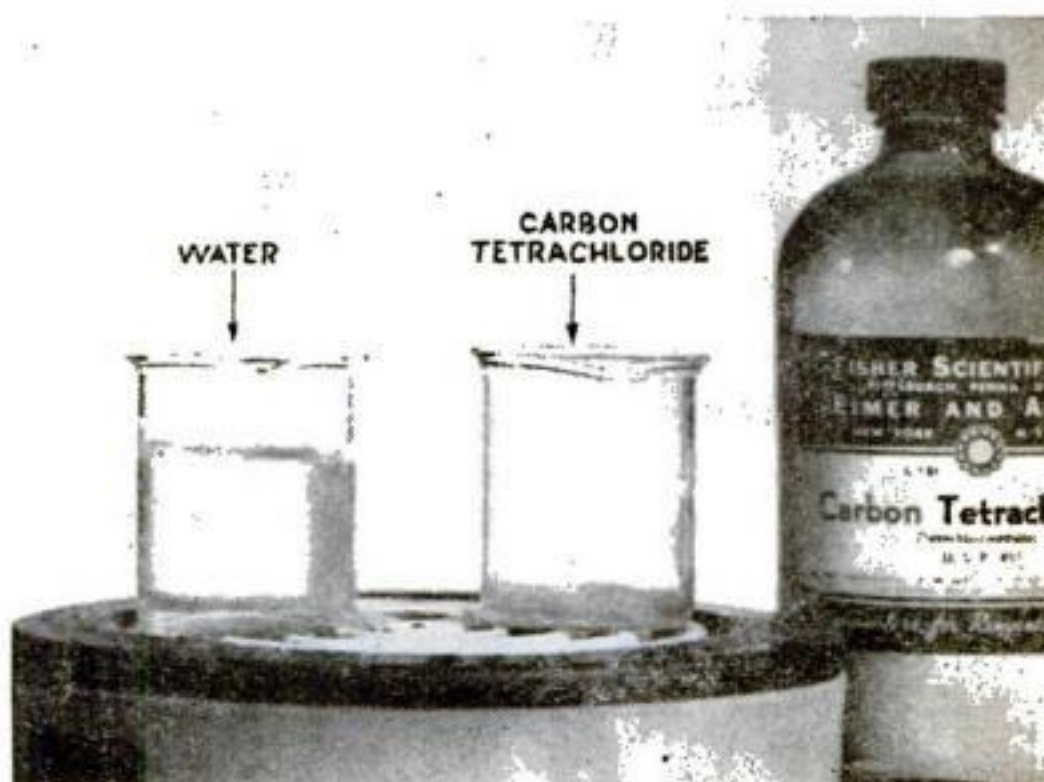
Another experiment will indicate why water possesses this great cooling and quenching action. Stand a small beaker of water alongside a similar beaker of carbon tetrachloride on an electric hotplate and watch what happens as the liquid warms up. (Perform this experiment in a well-ventilated room.) In a short time the carbon tetrachloride will begin to boil, followed later by the water. This difference is to be expected, since carbon tetrachloride boils at 76.7 deg. C. and water at 100, but a great difference develops in the rate of boiling away. Under ideal conditions, the carbon tetrachloride will boil away about 10 times as fast as the water.

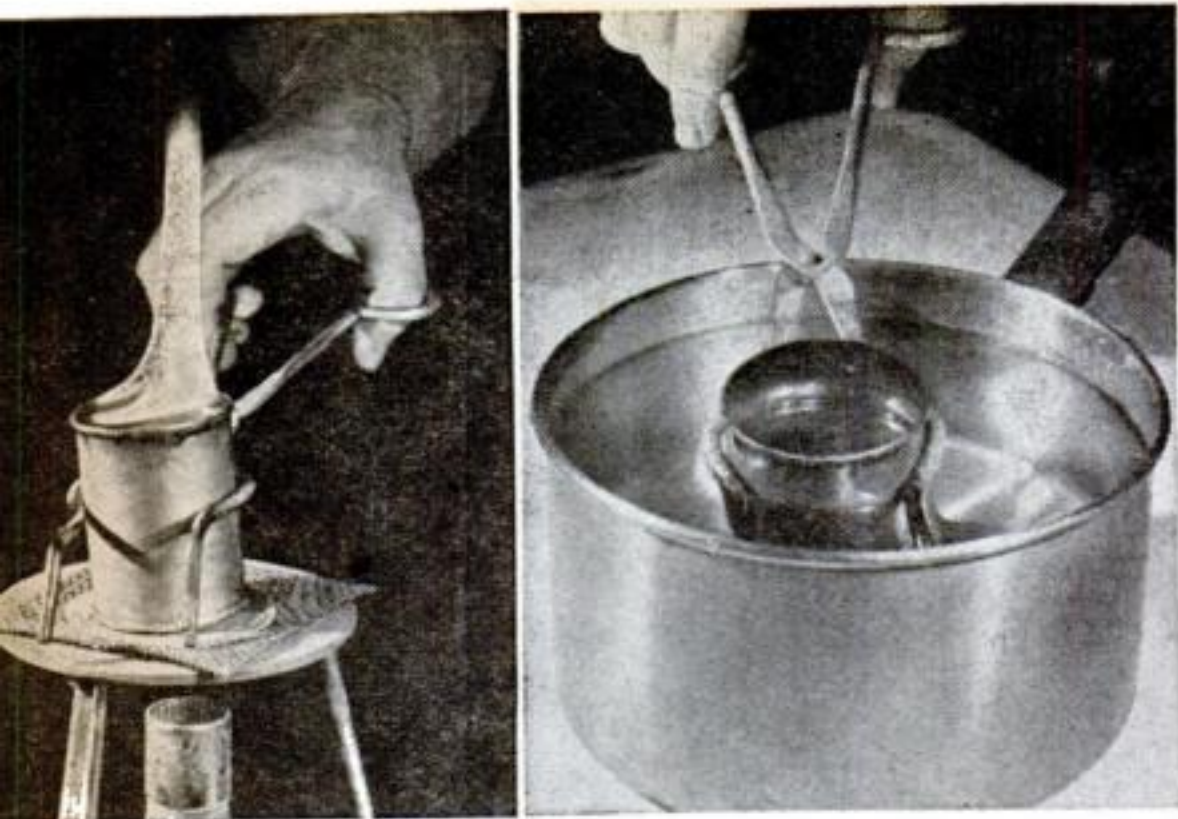
What does this difference mean in terms of fighting fires? It means that, as far as the cooling effect is concerned, water will extract about 10 times as much heat from a fire,

Carbon tetrachloride boils away faster than water, as shown here, but the water absorbs 10 times more heat. Consequently, water does a better job of putting out a fire, for it cools the flames much more.

pound for pound, as will this other popular fire-extinguishing medium.

A fire sometimes can be extinguished by the cooling effect of water without direct contact between the water and the burning material. To demonstrate this, melt some paraffin wax in a small can over a Bunsen flame and continue heating the wax until the vapors burn continuously after being ignited with a match. Then grasp the can with tongs and carefully lower it nearly to its top in a pan of cold water. (Be careful not to spill water on the burning wax, or it will spatter violently.) Soon the flame will





How a fire may be extinguished simply by cooling the burning substance is illustrated above. Heat a can of paraffin wax until a match will ignite the vapor. Then thrust the can in cold water. When the wax has cooled, the flame will go out.

become smaller, then it will flutter, and finally it will go out—the water having lowered the temperature of the wax below its fire point.

Most dry-powder extinguishers depend upon the combined cooling and smothering effect of bicarbonate of soda, sprayed on the flame as a dust. You can show this by placing a little in the end of a paper tube and blowing it suddenly on a small fire similar to the one you made for the first water experiment. If the dust is blown properly, the fire will go out with little or no delay. The explanation of this involves an interesting chemical reaction. Immediately on being heated, bicarbonate of soda decomposes into sodium carbon-



Oil and gasoline fires must be smothered by cutting off the oxygen supply. At the left above is a fire made by lighting a little gasoline floating on water. This fire is easily extinguished by covering the can with cardboard, center. Never use water, for it only spreads the flames, as demonstrated at right.

If allowed to vaporize, carbon tetrachloride will extinguish oil fires. As a demonstration, saturate a bit of cotton with this chemical and hold it over the fire, as at the right. The vapors will smother the flame.

Carbon dioxide also is widely used for oil fires. Prepare a little of this nonburning gas by adding vinegar to ordinary baking soda in a pitcher. Then quickly pour the gas over your fire, as shown at far right, and it will go out.





Foam extinguishers smother a fire because of the presence of carbon dioxide. You can make such a foam by preparing a solution of alum, another of bicarbonate of soda and gelatin, and then mixing the two.

ate and carbon dioxide. The reaction extracts a large amount of heat from the fire and, in addition, the carbon dioxide acts as a smothering agent. Dry extinguishers are especially good for small oil fires.

As we have shown, water is an excellent extinguisher for ordinary combustibles, but it does more harm than good when thrown upon such burning liquids as oil and gasoline. Since water is heavier, it sinks beneath these liquids, often causing them to overflow and spread the flames.

You can prove this fact in a series of simple experiments. For all the tests, stand a small tin can in the center of a cake tin resting on another that has been inverted. Fill the can nearly to the top with water, and then pour a little lighter fluid or gasoline on the water. (Use only very small quantities of inflammable fluids, and perform the experiments in the open if possible.)

When you ignite the fluid or gasoline, the fire will look rather formidable, but it can be extinguished with ease by covering the can with a lid, book, or even a sheet of cardboard. Pour water on the fire and the burning liquid will spill over into the pan. If improperly used, even carbon tetrachloride, the chief chemical used in the small pump-type hand extinguisher, will be ineffective and spread such a fire. Squirted into the flame in a solid stream, the

carbon tetrachloride will go through the layer of burning oil and do no good. But if the stream is directed against the farther inside surface of the can above the burning oil, the carbon tetrachloride will scatter into droplets which the heat will vaporize. The noncombustible vapor will smother the fire.

Carbon dioxide and methyl bromide are our most efficient means of smothering an oil fire. Both are supplied in containers in liquid form. When projected on a fire as a liquid spray, each immediately turns into a heavy nonburning gas. Of the two, methyl

bromide is more expensive, but, weight for weight, it is more effective than carbon dioxide.

Carbon dioxide trapped in foam also is used as an extinguisher. You can make a demonstration foam by dissolving half a teaspoonful of alum in an ounce of water in one tall glass, and a half teaspoonful of bicarbonate of soda plus a little powdered gelatin in

the same amount of water in another glass. When mixed together, the two clear solutions form a thick foam many times the original volume of the liquids. Chemically, the bicarbonate of soda reacts with the alum to release carbon dioxide bubbles. These are stabilized by the gelatin.

Carbon tetrachloride, carbon dioxide, methyl bromide, and dry chemicals are all effective for electrical fires.

HOW TO FIREPROOF SANTA'S SUIT

IF SANTA is coming to your home this year, it would be well to make his suit and whiskers fire resistant. Prepare a mixture of 2 oz. carbonate of soda, 2 oz. ammonia carbonate, 2 oz. boric acid, and 5 gal. water. Boil, strain, and spray on the material.

Home Repairs with RUBBER TAPE

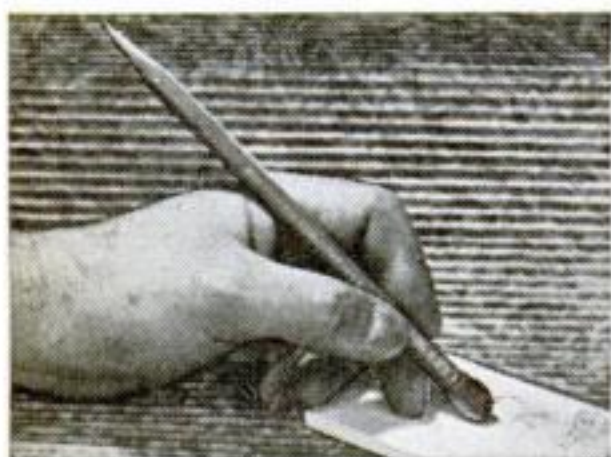


Finger-saving grips for scissors and shears can be made from rubber tape by placing strips around the handles lengthwise and pressing the edges.

COMFORTABLE grips for tools, small protective "bumpers," replacement tires for vacuum cleaners—these and numerous other handy-around-the-house articles can be made from electrician's live-rubber insulating tape (not friction tape), sold in most dime stores.

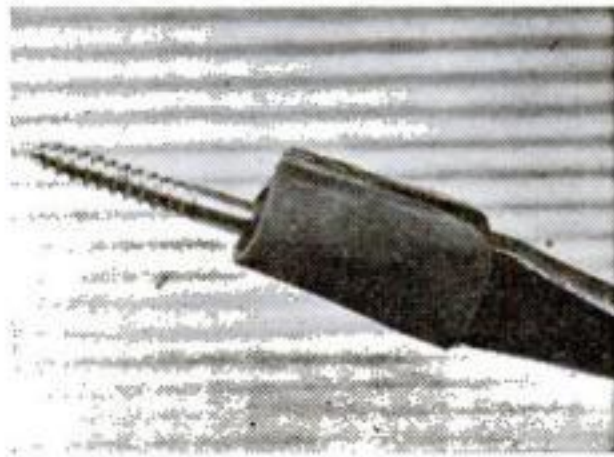
Since it sticks to almost any dry surface and adheres to itself permanently, smooth and resilient tool grips can be made by closely spiralling tape around the handles and pinching the edges together. Covering furniture legs and backs with inconspicuous bits of rubber tape will prevent scratches on floors and walls. For small no-mar bumpers, simply stretch tape over carpet tacks, gather the excess, and press it on the back of the head, trimming away the remainder.

Worn rubber tires on vacuum cleaners and sweepers can actually be retreaded by covering them with strips of tightly-stretched rubber tape.—KENNETH MURRAY.



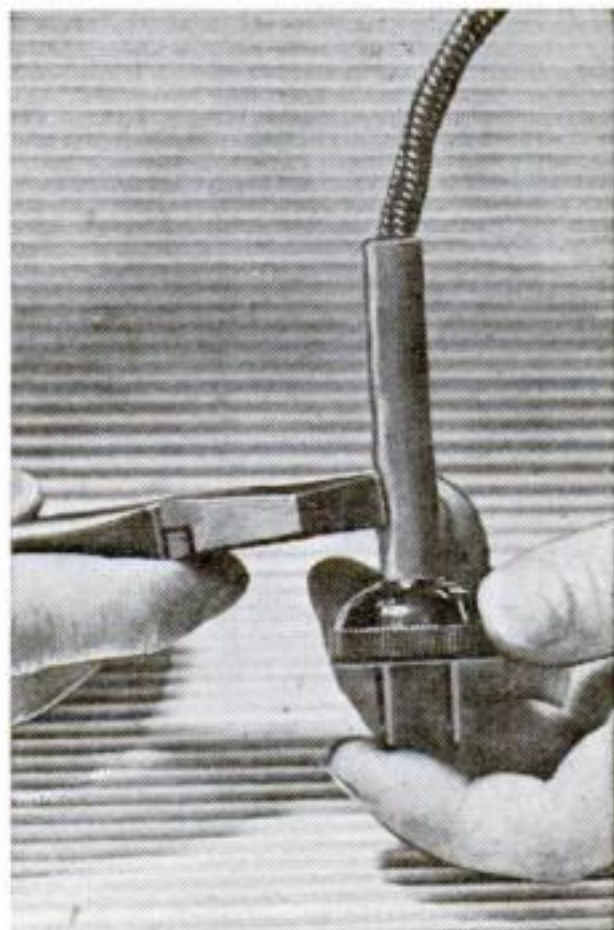
A bit of rubber tape stretched over the end of a drawing pencil provides an efficient eraser.

For one-handed screwdriving, fasten the screw to the screwdriver with a short length of tape.



Rubber tape wound in a spiral around a nail file will provide a comfortable handle. Pinch the edges of the tape and trim any overlap to make a neat, permanent job.

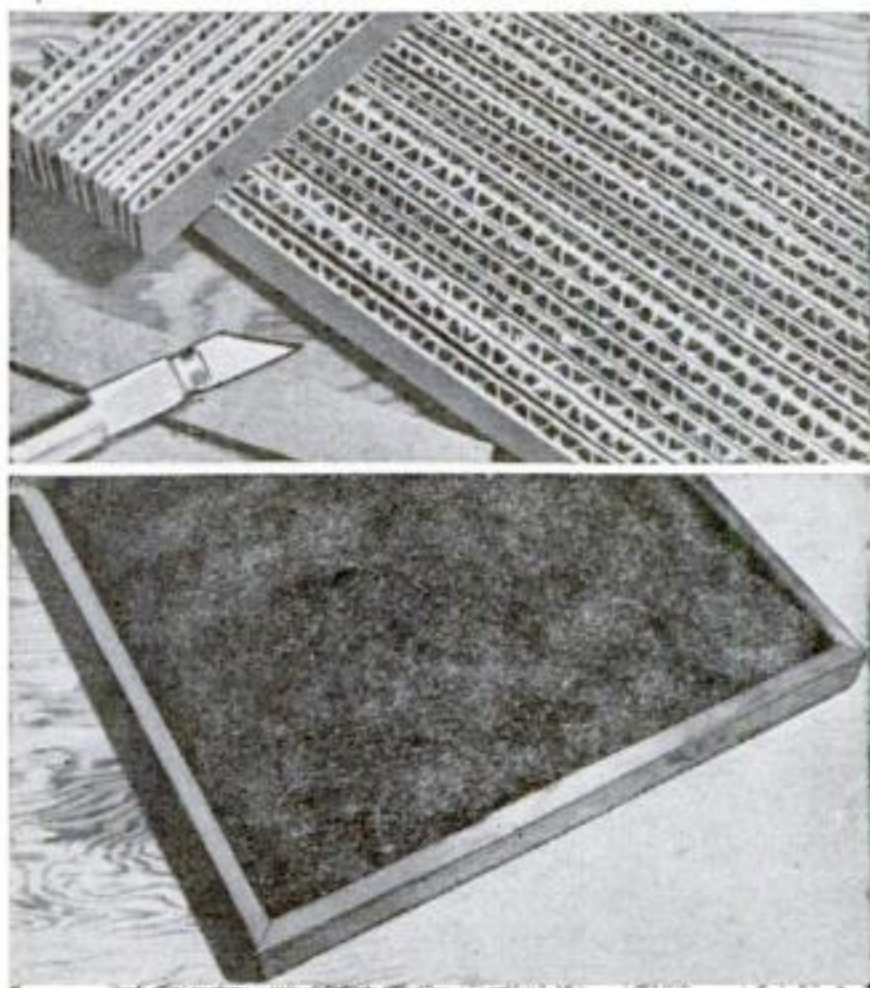
To prevent strain on electric cords when they are pulled from sockets, wrap tape around the wire, starting close to the end. Roll over one end to make a protective flange.



Grain Scoop from Scrap Pipe

QUICK, accurate distribution of feed is easy with this grain scoop made of junk-pile materials. The scoop section is constructed from a short piece of galvanized stovepipe cut in half and nailed around a semicircular wood back that has been sawed to the same radius as the stove pipe. Taper the front end by cutting off the corners with tin snips.

For the handle, a section of water pipe is used. Slot one end to fit over a brace made of bent strap iron riveted at both ends to the stovepipe. The other end of the pipe handle rests in a snug-fitting hole in the wood back. Finish the grain scoop by smoothing sharp corners on the stovepipe and back.—J. P.



Make Your Own Furnace Filters

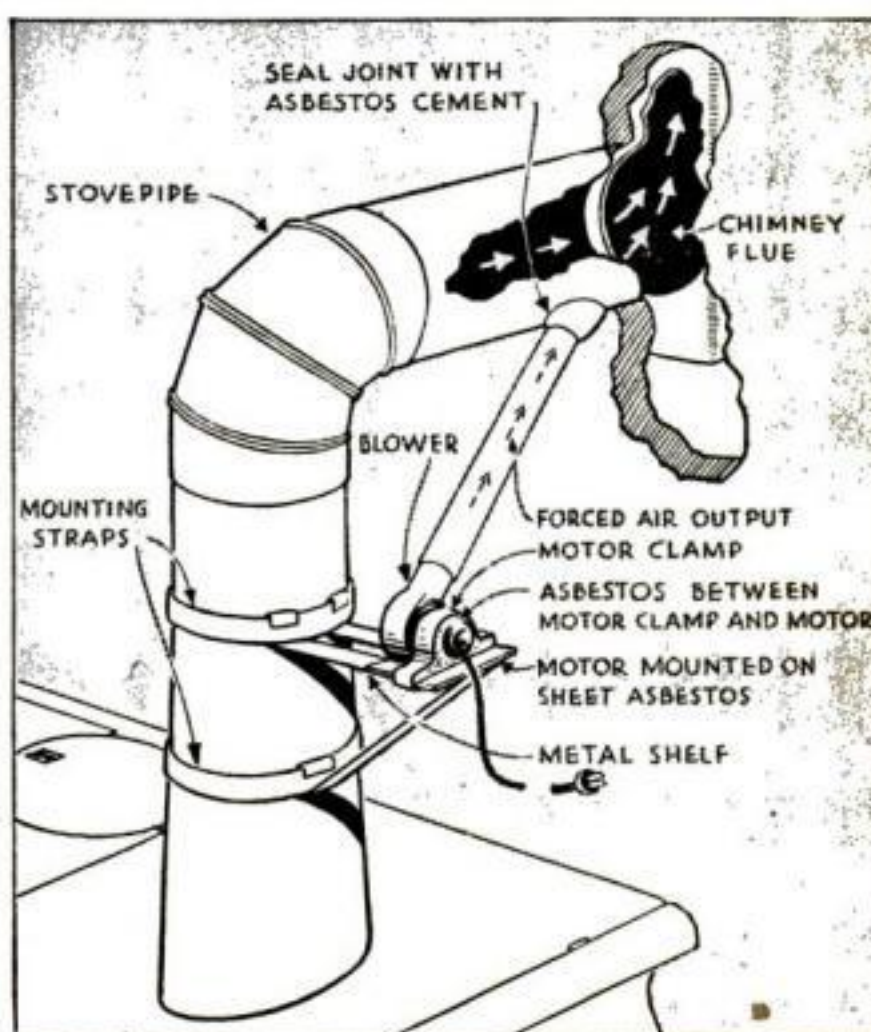
REPLACEABLE filters for the forced-air heating systems installed in many homes can be made easily from inexpensive materials. The frame, dimensioned to fit the particular furnace, consists of four $\frac{3}{4}$ " strips of scrap wood nailed together with a window-screening bottom.

For filler, either steel wool or corrugated cardboard will serve. Grade 0 or 1 steel wool should be soaked in oil, drained, and packed loosely in the frame. If cardboard is used, cut $\frac{3}{4}$ " strips with a sharp knife, oil, drain, and stack in the frame in two crisscrossing layers.—WILL THOMAS.

Blower Stops Smoke Blow-Back

ATMOSPHERIC down drafts will no longer fill rooms with back-firing smoke from the coal range when the stovepipe is equipped with a forced-air blower. The electrically operated blower counters the down drafts common in mountainous regions with a stream of air that keeps the chimney working in the right direction.

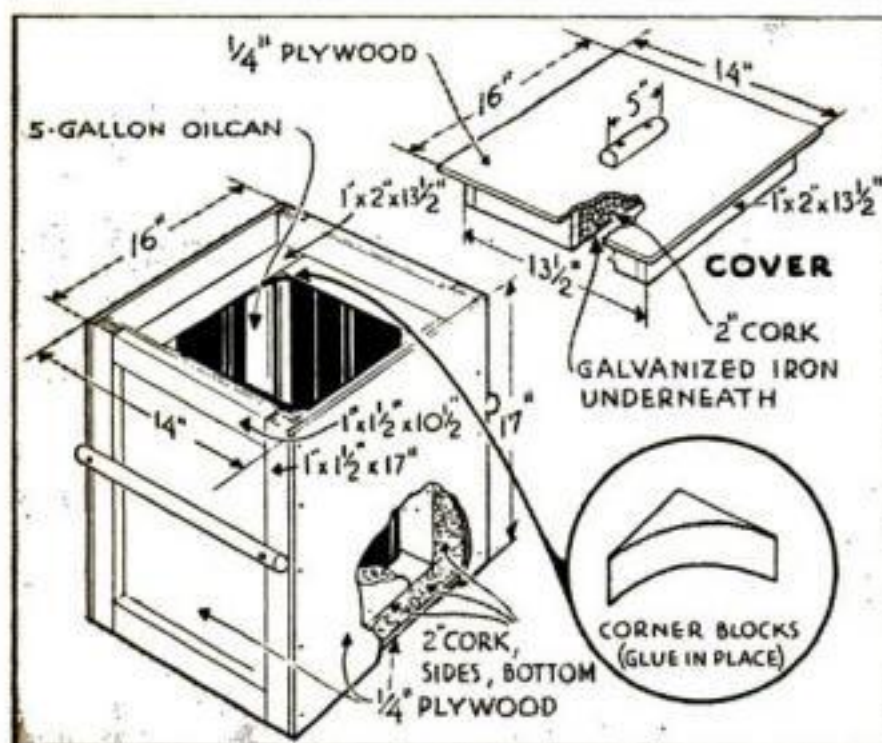
For the installation shown in the sketch, an inexpensive blower designed to cool powerful radio tubes was used. Driven by a $\frac{1}{200}$ hp. motor, its speed can be adjusted to outblow most drafts.—H. T. MILLER.



FOR EASIER FARMING



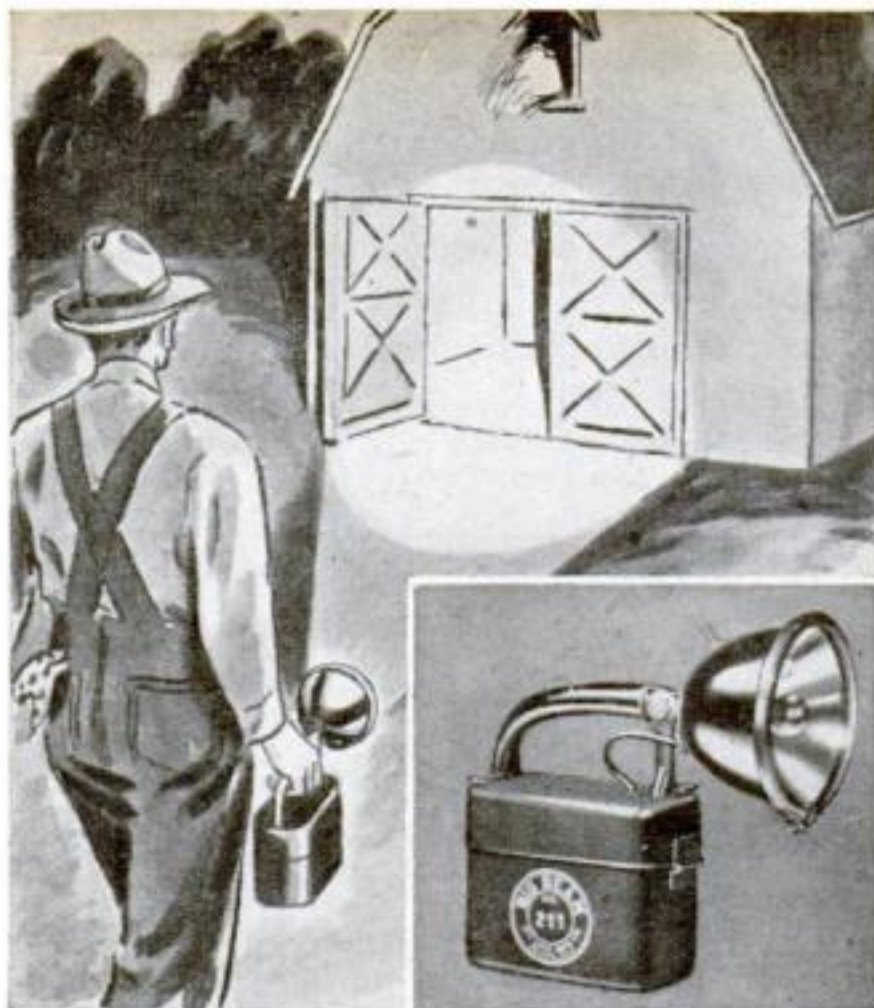
EVEN THE SMART RATS fall for this catcher, a sack tied to a covered runway made by nailing mesh to a board. It's placed in front of the rats' favorite exit from the chicken house. When I go inside with a flashlight, the rodents dive for the exit. I block it with a brick, go outside, and kill them in the sack.—WILLARD D. MORGAN.



A FROZEN-FOOD CONTAINER that prevents thawing when supplies are taken home from the freezer plant costs little to build. A 5-gal. oil can, some 2" cork, and plywood or fiber board are the chief materials needed.

Cut the top off the oil can and enclose the remaining five sides with at least 2" of cork or other good insulation. Build a box of plywood or fiber board around this assembly. The cover, insulated like the can, should be made carefully so that it fits tightly.

With a piece of dry ice inside, the box could also be used to keep ice cream hard or bring freshly caught fish back home from a camping trip.—RALPH S. WILKES.



BRIGHT LIGHT anytime and anywhere is afforded by an electric hand lantern that focuses a 1,500' beam or a broad spot at the turn of a single adjustment. Weighing only 5 lb., it has an auxiliary bulb for use when less light is needed. Two standard dry cells are connected by pressure contacts that require no wires. U-C Lite Manufacturing Co., Chicago, is the maker.

PROPERLY SPACED SEEDS are planted by a new lightweight farm implement made largely of aluminum. The "Equa-Space" seeder, distributed by the Midwest Co., Minneapolis, Minn., can handle a wide variety of seeds from turnips to lima beans. Using a new brush assembly instead of metal parts to control flow, it eliminates waste resulting from broken or crushed seeds. It weighs 28 lb.



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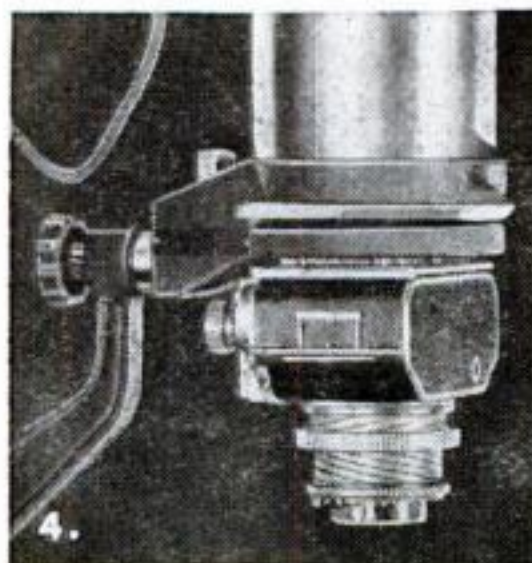
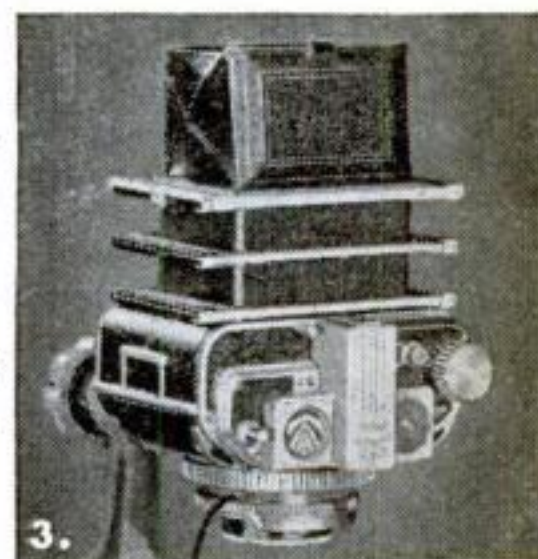
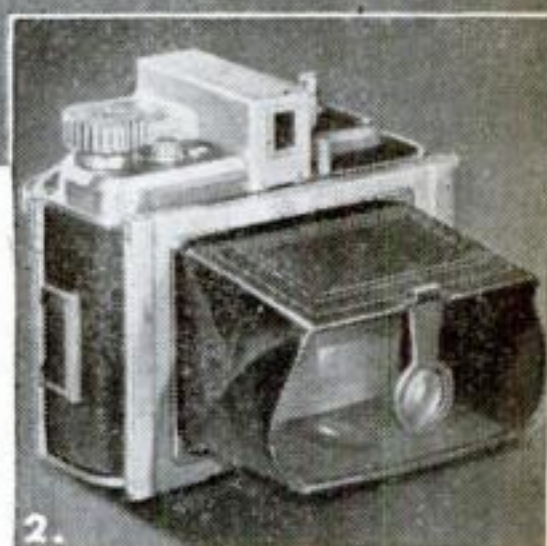
THE KODAK MEDALIST II differs from other cameras . . . it is different in appearance, in scope, and in adaptability to an almost endless variety of photographic jobs. For you, this means that it is really several cameras in one—and all of them excellent.

Kodak Medalist II gives you the convenience of 620 ($2\frac{1}{4} \times 3\frac{1}{4}$) roll film—black-and-white or Kodacolor; refinement equal to that of a true precision miniature; and—with various accessories—back extension, ground-glass focusing, and the means for using film in packs or sheets. In sheet film you have a choice of black-and-white, Kodachrome, or Ektachrome Film. And you can readily adapt your Medalist for high-grade enlarging and copying.

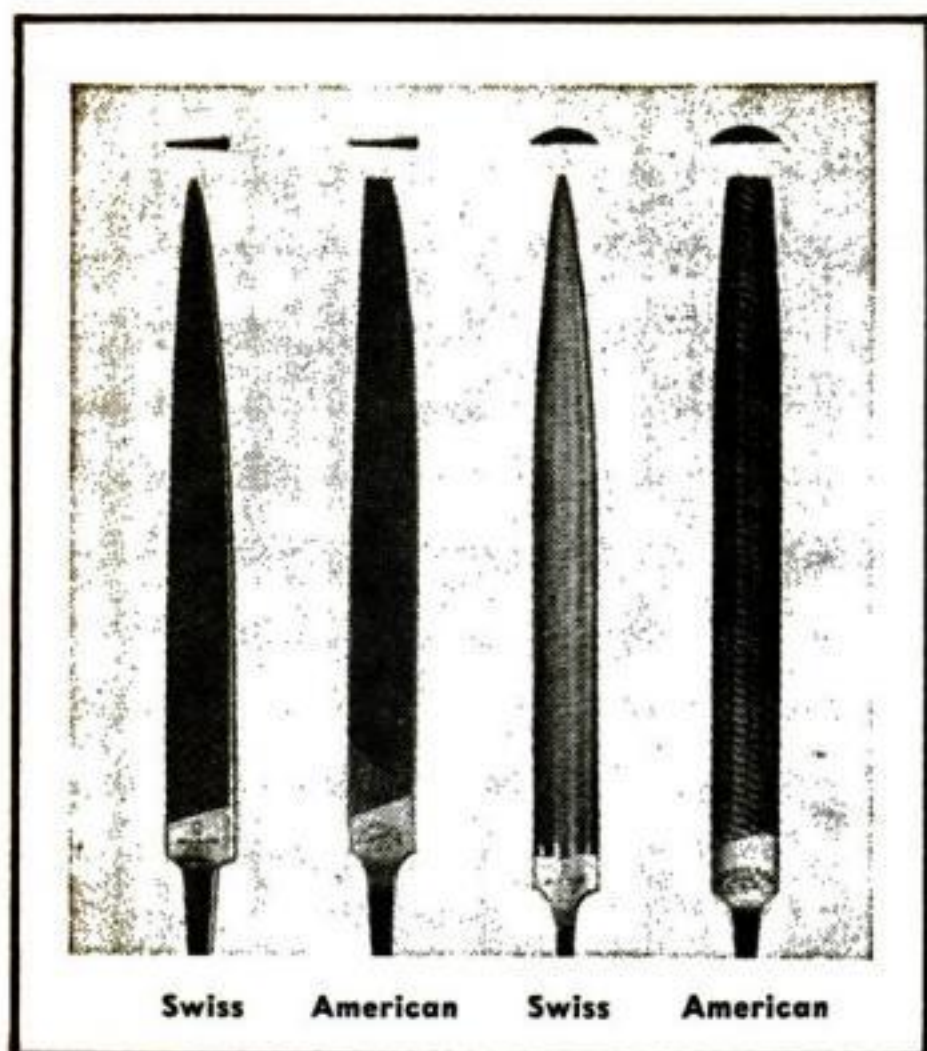
The lens is the highly corrected Kodak Ektar 100mm. $f/3.5$, finest in the $2\frac{1}{4} \times 3\frac{1}{4}$ field; superbly mounted, and *Lumenized* (hard-coated on all glass-air surfaces) for maximum light transmission and color purity, and minimum loss through reflection.

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For further details see your Kodak dealer . . . Eastman Kodak Company, Rochester 4, N. Y.

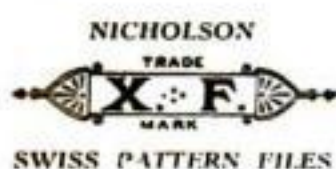


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2. A film-pack, sheet-film camera with both range finder and ground-glass focusing
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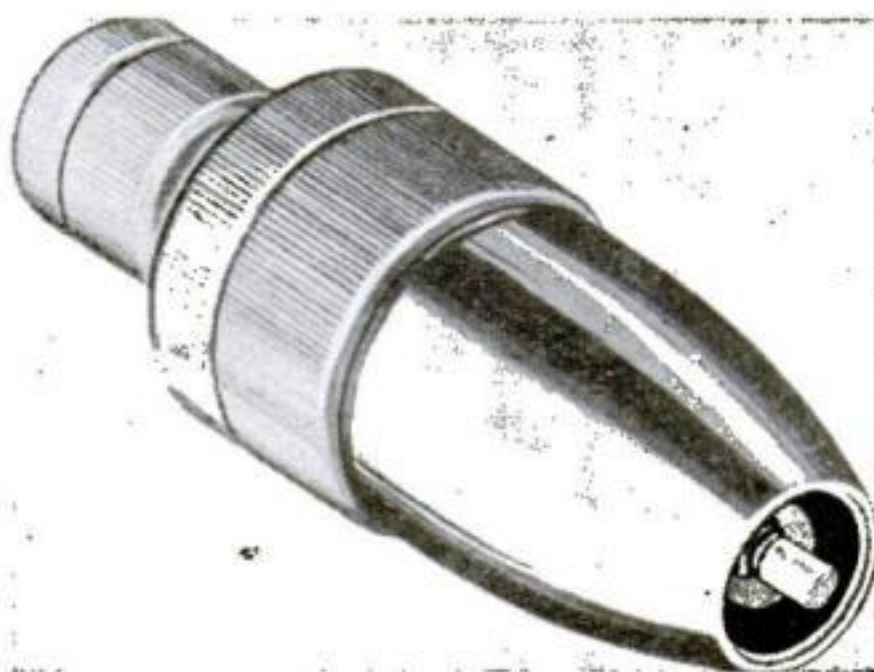


**NICHOLSON
FILES** FOR EVERY PURPOSE



Experimental Pottery Design

A RECENT exhibition of design trends in home furnishings, held at the Museum of Modern Art, New York City, included these samples of experimental earthen pottery. Developed at the Chicago Institute of Design, pieces of the informal tea service are stamped from sheets of clay.



Cleanable Shower Head

PRESSING a button on the face of the Presto shower head dislodges any accumulation of scale or sediment, insuring a free flow of water. Made by the Repeal Brass Co., of Los Angeles, the bullet-shaped chrome-plated head has no holes or face plates to clog or stick.

PACKARD CableGRAM

FROM: Your friendly Packard Cable Serviceman TO: Car Owners who like good performance

YOUR PACKARD CABLE DEALER OPERATES A SERVICE STATION, GARAGE OR CAR DEALERSHIP—KNOWS AUTOMOTIVE WIRING FROM A TO Z.

HERE ARE SOME OF THE CAR TROUBLES HE LICKS WITH PACKARD CABLE :

AND I THOUGHT SEALED BEAM HEADLIGHTS WERE POWERFUL!



FRAYED OR UNDERSIZED LIGHTING WIRES CAN CUT CANDLEPOWER IN HALF—REPLACE WITH PACKARD CABLE FOR BRIGHTER HEADLIGHTS

WHAZAMATTER WITH THE %X& BATTERY IN THIS CAR?



DON'T ALWAYS BLAME THE BATTERY—IT MAY BE CORRODED OR UNDERSIZED BATTERY CABLES. FOR SURE STARTING—REPLACE WITH PACKARD BATTERY CABLES.

COMIN' FAST



WASN'T HE?

INDIANAPOLIS RACE

EVERY WINNER OF THE INDIAN—APOLIS RACE EXCEPT ONE SINCE 1928 HAS USED PACKARD SPARK PLUG WIRES. REPLACE OLD SPARK PLUG WIRES WITH PACKARD FOR PEP, POWER, PERFORMANCE

PACKARD CERTIFIED RE-WIRING SERVICE

This sign means cable service at its best—the right Packard cable and the right methods. Thousands of dealers provide better electrical service as a result of the Packard Certified Re-Wiring Program.



Packard
REG. U.S. PAT. OFF.
TRADE MARK

PACKARD ELECTRIC DIVISION
GENERAL MOTORS CORPORATION
WARREN, OHIO

FOREMOST BUILDER OF AUTOMOTIVE AND AVIATION WIRING

DEC. 211
1946

YOU'RE RIGHT WITH PACKARD CABLE!

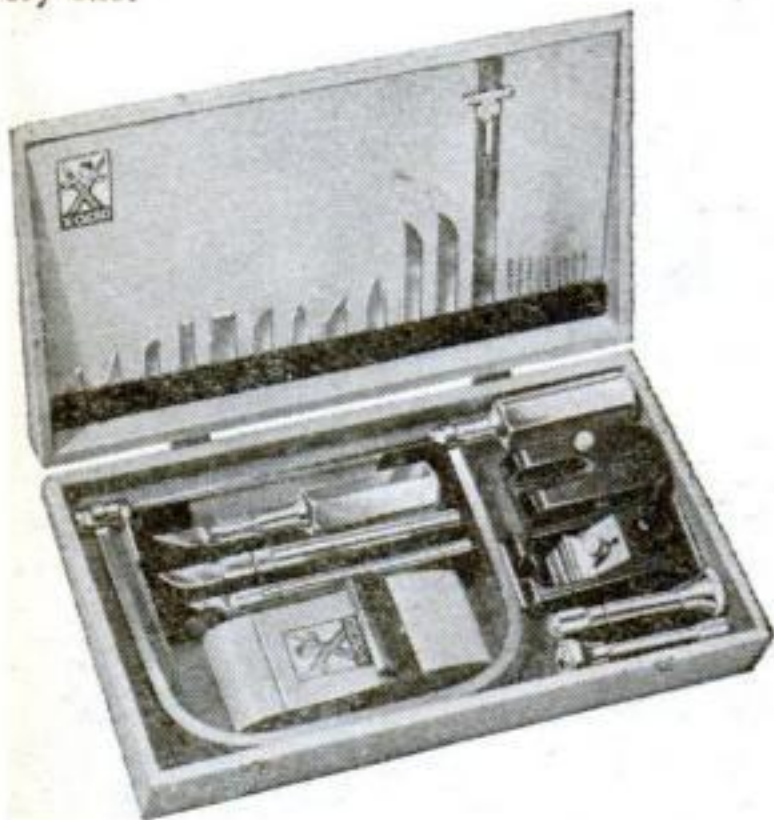


For a Merry Christmas and a

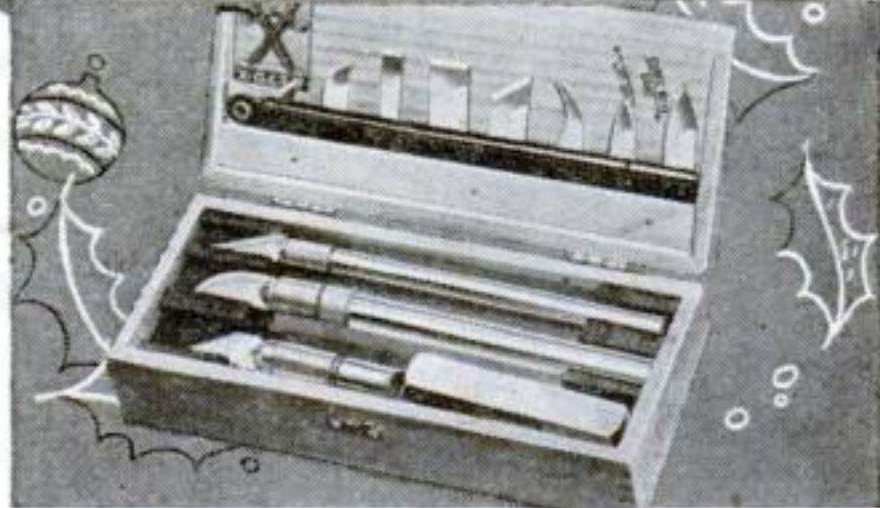
Hobby New Year

X-ACTO KNIFE AND TOOL CHESTS

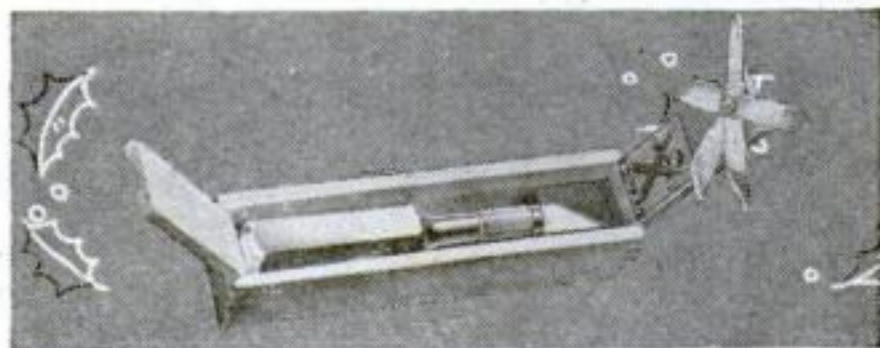
Hobbycrafters' dream gift, for amateurs or experts. Knives are *all-metal*. (No more substitute plastics!) Blades scalpel-sharp, with 13 different shapes. Tools especially designed for those small hobby jobs. Here are three of X-acto's many fine gift chests . . . and there's a barrel o' fun in every one!



THE BIG SHOT — No. 85 X-acto Tool Chest. A Knife, a tool for every job: 3 knives; assorted blades; sander; stripper; saw; drills and holders; ruler. It's got everything! Complete in desk-drawer-size wooden chest, \$12.50.



THE 3 MUSKETEERS — No. 83 De Luxe X-acto All-Metal Knife Chest: 3 duraluminum X-acto Knives, with 23 assorted blades. Perfect tools for arts, crafts, and model building; for tough or ticklish jobs; for wood, paper, leather, plastics. Chest—complete, \$5.00.



No. 80 WHITTLER'S SET — Hefty but easy-to-handle X-acto Knife, with assortment of five extra whittling blades. Vise-like collet locks in blades so they can't fold under. Firm control adds skill to the wrist, makes whittling *easy*! Complete in wooden box, \$2.



x-acto

KNIVES & TOOLS

At hobby, hardware, gift shops



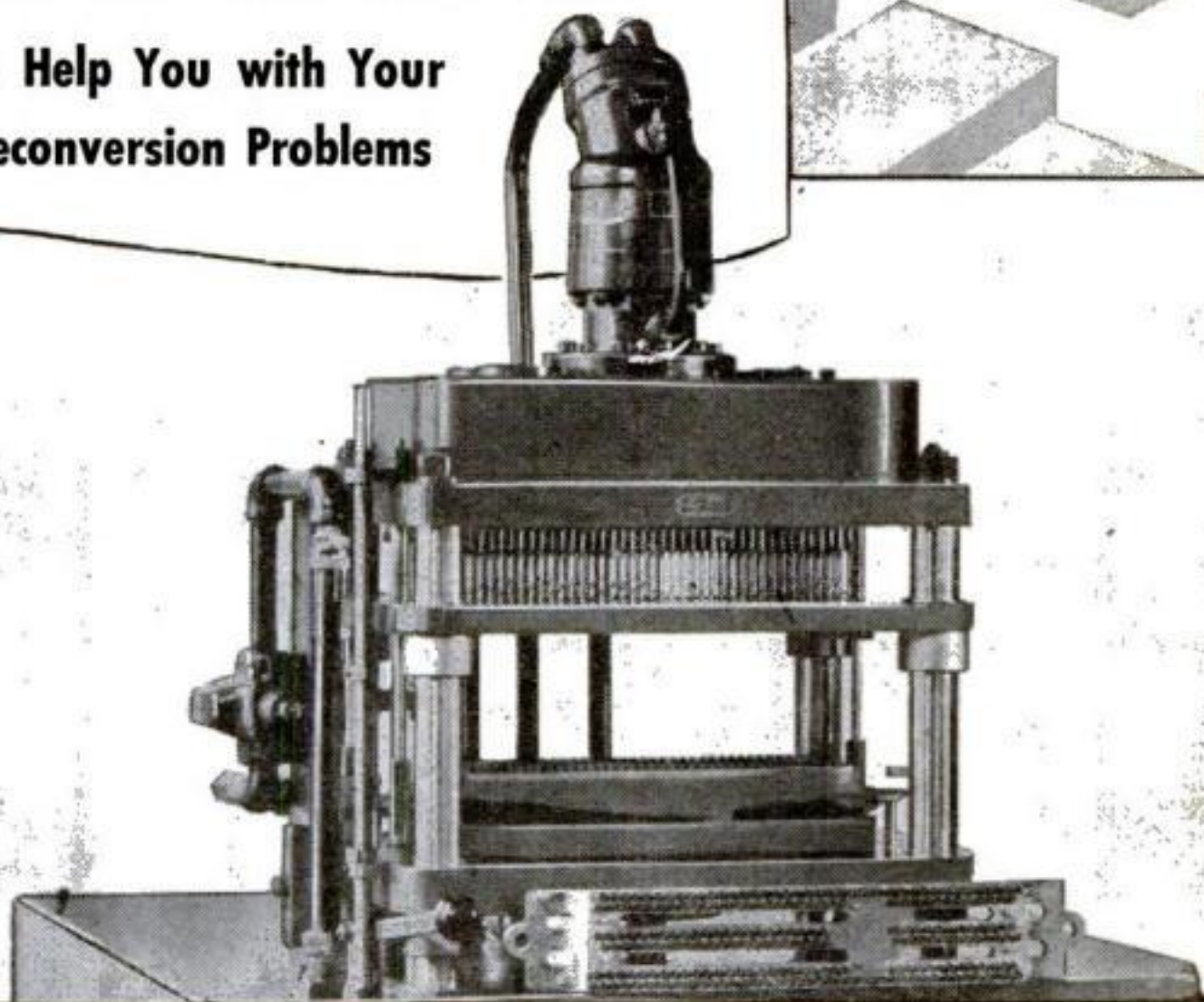
REG. U. S. PAT. OFF.

X-acto Hobby Knives and Tools — Singly or in sets —
50c to \$12.50

X-acto Crescent Products Co., Inc., 440 Fourth Avenue,
New York 16, N. Y. In Canada: Handicraft Tools,
Ltd., Hermant Bldg., Toronto.

Ingenious New Technical Methods

To Help You with Your
Reconversion Problems



12,000 Holes per Hour! With New Gearless Multiple Spindle Drillhead!

The **Zagar Gearless Drillhead** can accommodate up to 400 drills in one head—drill up to 400 holes at one time! This revolutionary unit runs noiselessly and vibration-free on needle, tapered roller and precision ball bearings, and is lubricated by a patented automatic oiling system to insure trouble-free operation.

With this unit all holes are drilled at one pass, and valuable time is saved by the elimination of indexing and extra handling. It may be used on standard drill presses, or furnished as a complete hydraulic machine by the factory.

Another time saver, as well as a help on a tedious job, is chewing gum. The simple act of chewing seems to make the work go faster, easier—helping to relieve worker's fatigue—so that a better piece of work can be turned out with greater safety. Wrigley's Spearmint Gum may be used even when both hands are busy—right where the work is being produced.

*You can get complete information from Zagar Tool, Inc.
23881 Lakeland Blvd., Cleveland 17, Ohio*



Zagar 220 Spindle Gearless Drillhead



AA-202

DEC.
1946 213

For jobs like this...



—But for gluing **UNLIKE** surfaces,

CASCO FLEXIBLE CEMENT

Wood to metal . . .



Leather to fabric . . .



Plastic to felt . . .



Withstands shocks . . .
resists moisture . . .
clean and easy to use!

25¢ AT YOUR HARDWARE STORE

CASEIN COMPANY OF AMERICA • NEW YORK 17, N. Y.



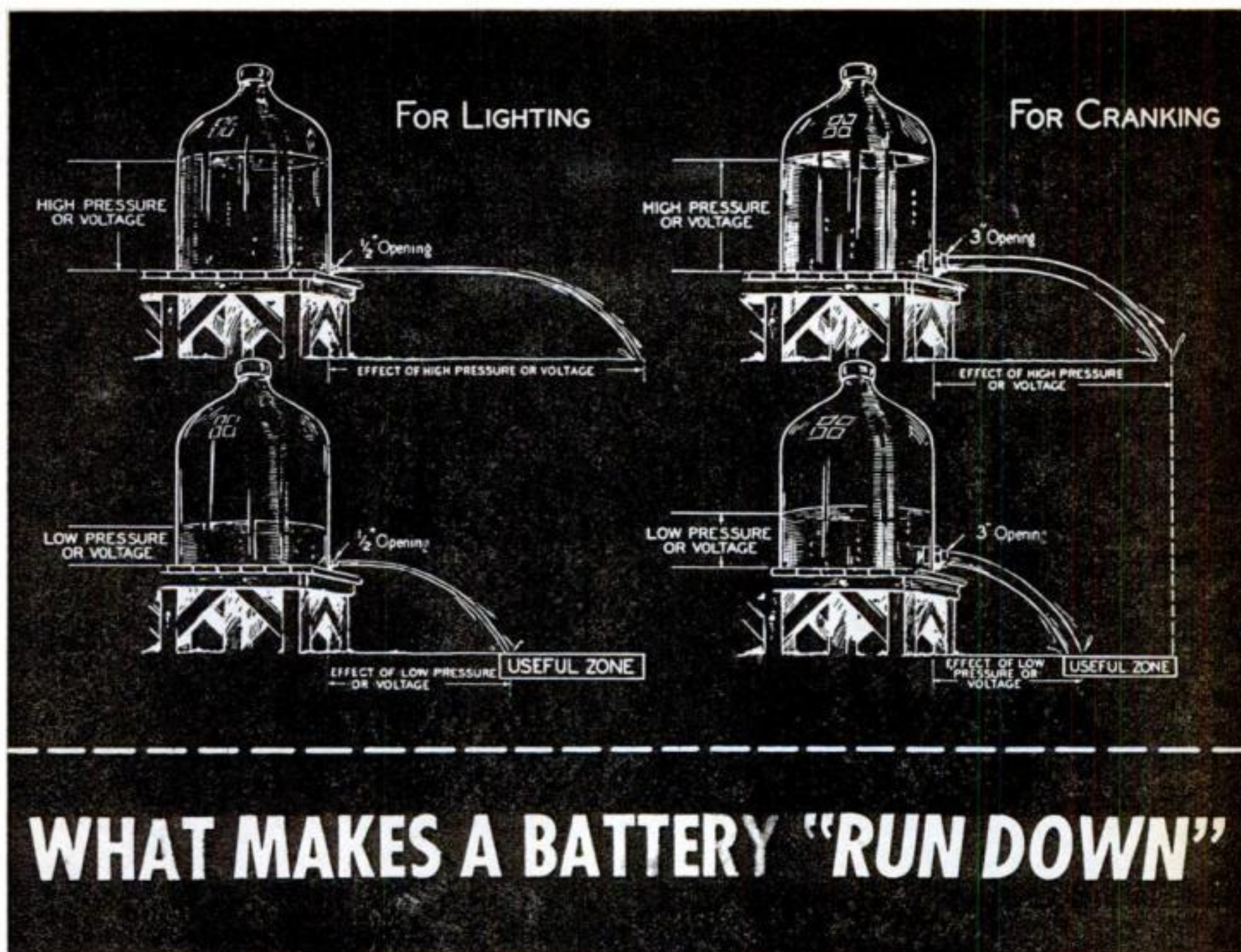
Leash Has Automatic Reel

TO SIMPLIFY control of a dog, the Promenader leash has a thumb-operated brake that checks it at any length and a reel that automatically rewinds the 10-foot plastic cord when the pull is removed. The Inventors Products Corp., of Chicago, makes it.



Bicycle Gets Extra Wheels

THE convertible bicycle devised by Clyde Kutil, of Sioux City, Iowa, can be changed to a "quadricycle" by merely pulling a lever. The two extra wheels at the rear drop to the ground, giving greater stability for beginners or handicapped persons. The same lever raises the wheels when they are no longer wanted.



WHAT MAKES A BATTERY "RUN DOWN"

A storage battery, like a water tank, can deliver only what it contains. The quantity of current it can supply is gauged by its capacity—voltage multiplied by amperage.

VOLTAGE means pressure of electric current, just as "pounds per square inch" indicate water pressure. **AMPERAGE** measures the flow of electric current per hour, just as "gallons per minute" measures water flow. **CAPACITY** means the quantity of electricity delivered in a definite time.

The faster a battery is discharged, the quicker the pressure drops. More current is consumed in cranking (starting) than in lighting, and power

is more quickly exhausted. This is clearly shown in the illustrations above.

Thus capacity is an important factor in determining the power and quality of a storage battery . . . and the kind of service it gives you.

Exide Batteries are noted for their high capacity, long-life, low cost per mile of operation and strong starting power.

"WHEN IT'S AN EXIDE YOU START"

Would you like to know more about batteries? The complete story is told in a booklet, "THE STORAGE BATTERY, Its Fundamentals, Use and Maintenance." Mail a postal card today for a FREE copy.

Exide

BATTERIES

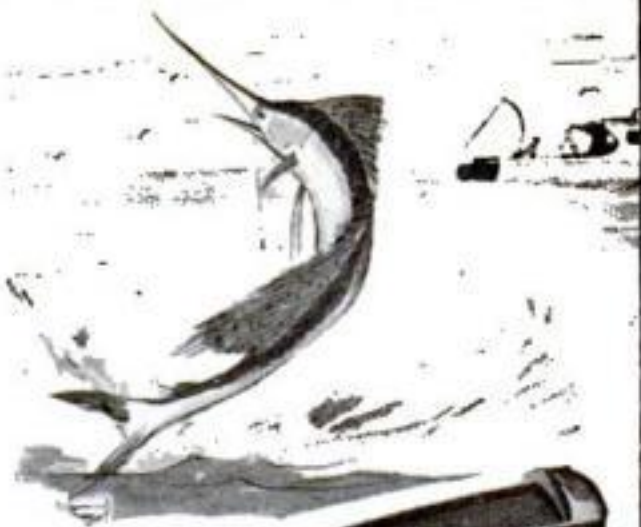
THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 32

Exide Batteries of Canada, Limited, Toronto

Of course it caught your eye . . .

Every man who knows pipes likes the looks of a Sportsman. That unique natural-burl finish is partly the reason. But mostly, it's the way a Sportsman is fashioned. That's fine imported bruyere you see—and there's plenty of it in bowl and shank, to absorb the heat and cool your smoke. If you want a *long* smoke—and a cool, sweet one—put your tobacco in a Sportsman.

SPORTSMAN
Champion of Pipes



From \$5 to \$15 in a wide range of shapes and styles, at better stores.

JOHN HUDSON MOORE, INC., 663 FIFTH AVE., NEW YORK 22

GET THE "BIG 3" OF

OUTBOARD MOTORING



It is Johnson that gives you the big three of outboard motoring: 1—Reverse, with 360° Steering. 2—Dual Carburetion, which makes low trolling speed possible in a powerful motor. 3—Perfected Alternate Firing, for silken smoothness. You get them *ALL* in a Sea-Horse! Plus 24 other quality features. Plus the advantage of our famous dealer-service organization trained and equipped to keep your Sea-Horse in tip-top condition.

Write for a copy of the new Sea-Horse Handy Chart, describing all Johnson motors. And see your Johnson dealer. Look for his name under "Outboard Motors" in your classified phone book.

JOHNSON MOTORS, 500 Pershing Rd., Waukegan, Ill.

JOHNSON SEA-HORSES for DEPENDability

'ROUND THE TOWN...

Switch to —
AUTO-LITE



MICHIGAN AVENUE—ONE OF CHICAGO'S BUSIEST TRAFFIC CENTERS

It's no fun fighting a stubborn engine in heavy traffic—and often so unnecessary. You may find all that is needed to cure that sluggish, unresponsive engine is to switch lazy, worn-out plugs for a new set of Auto-Lite Spark Plugs. When so

many, leading car manufacturers specify these ignition engineered spark plugs you can be sure money cannot buy a better product. Why take chances! Before another day is done stop at your Auto-Lite Spark Plug Dealer and switch to Auto-Lite.

Toronto, Ont. THE ELECTRIC AUTO-LITE COMPANY Toledo 1, O

Tune in DICK HAYMES
Star of the
AUTO-LITE
Radio Show with Helen
Forresi, Gordon
Jenkins Orchestra
and Chorus
THURSDAYS
9 P.M., E.T.—CBS



AUTO-LITE SPARK PLUGS
"Ignition Engineered"

MONEY CANNOT BUY A BETTER SPARK PLUG

DEC.
1946 217

2 SIGNS VERY VALUABLE TO YOU!



identifies the dealer equipped to test your engine oil Free!

No.2

the AC Oil Test that shows when dirty, gummy engine oil needs cleaning



If your engine oil is dirty, the dirt shows *plainly* when your dipstick is wiped on an AC Oil Test Pad. You can get that test, FREE, from any service man who displays the yellow-and-black official AC Sign. If the test shows that you need your oil filter element changed, or should have an oil filter installed, *that same service man* can do that for you. (Better have your oil changed at the same time.)

Don't drive with dirty oil! It wastes gasoline as well as oil. It clogs vital oil slots in piston rings. Let AC Oil Filters and Elements keep your engine oil clean and dependable.

AC SPARK PLUG DIVISION • GENERAL MOTORS CORPORATION

You'll Save Oil and Money-



If you have this precision engineered AC element installed

If you have this AC Oil Filter installed



OIL FILTERS



Flash Bulb Is a Repeater

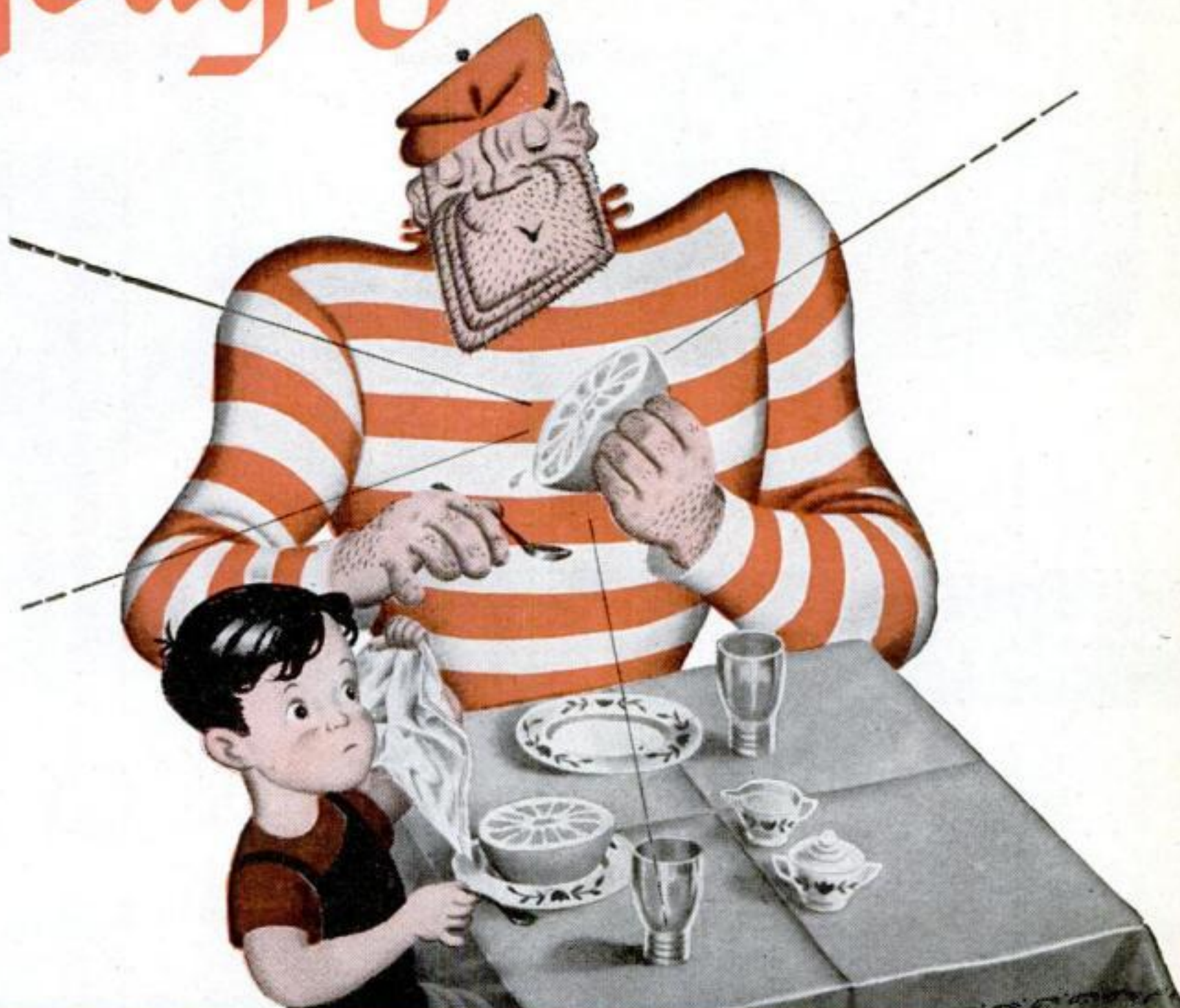
BY VIRTUE of its open-end spiral design, the new Amglo Speedflash photography lamp can be used thousands of times. In it electricity is passed through an inert gas and the resulting ionization causes a 1/10,000-second flash. Camera filters are unnecessary when it is used with daylight film. The lamp will not function, however, with an ordinary flash synchronizer, and requires its own Speedflash power pack.

New Plastic for Electronics

TEXTOLITE No. 1422, a new General Electric plastic, is expected to have wide electronic uses. Its electrical properties make it a good insulator, it is highly resistant to heat, and it can be machined to much closer tolerances than most plastics. An unusual chemical inertness further widens the possible applications of the material.

The plastic is particularly suited to microwave radio equipment, television, FM and radar. Tests of the new material indicate that under light electrical loads it maintains its shape at temperatures as high as 200 degrees C. Textolite No. 1422 is adaptable to small-quantity production.

Tough BUT OH SO GENTLE




When your automobile engine starts pumping oil or smoking, it will pay you to install Hastings piston rings. They *stop* oil-

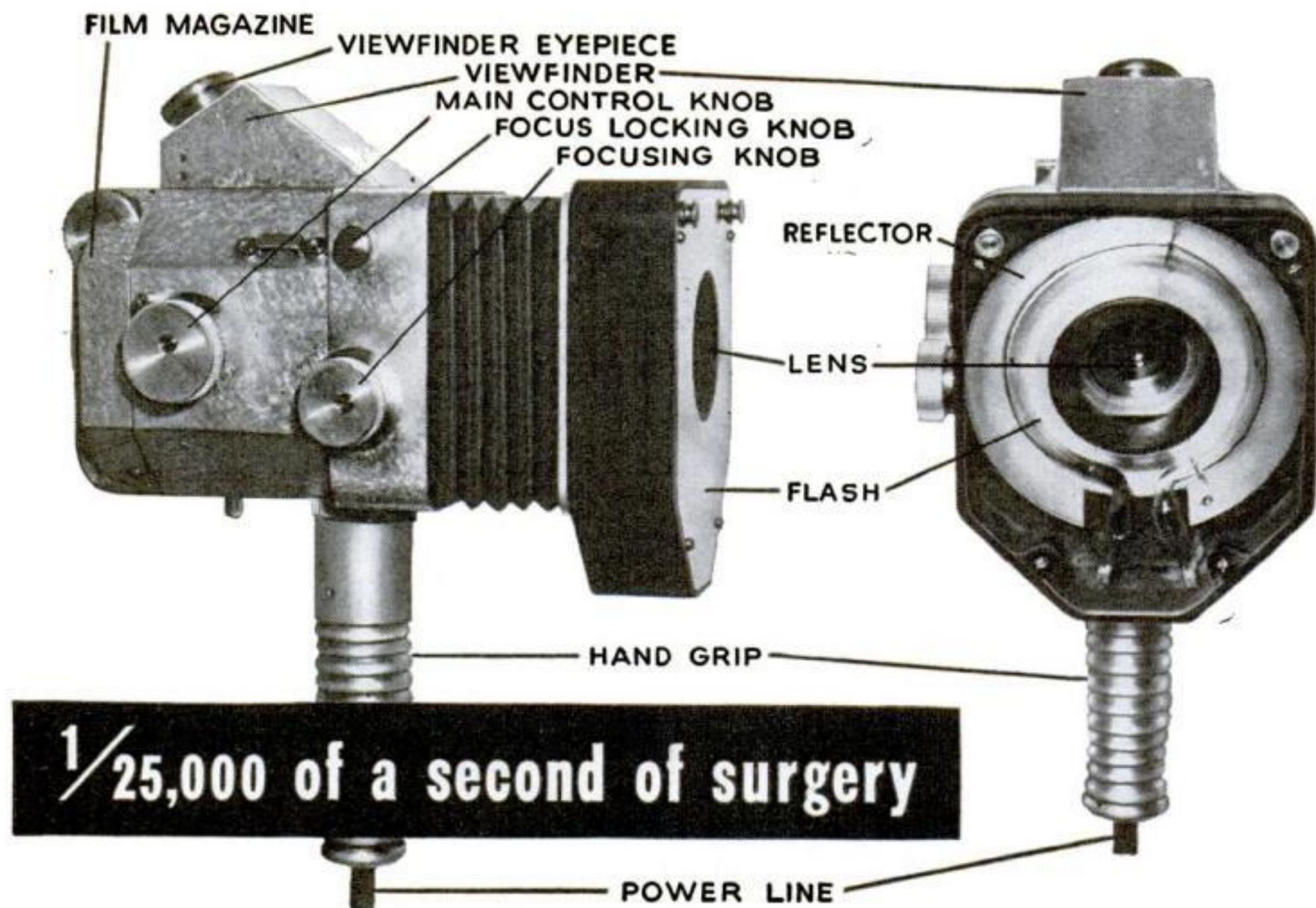
pumping, *check* cylinder wear, *restore* engine performance. Ask your motor specialist.

HASTINGS MANUFACTURING CO. • HASTINGS, MICH.
Hastings Ltd., Toronto

HASTINGS STEEL-VENT
PISTON RINGS



TOUGH ON OIL-PUMPING GENTLE ON CYLINDER WALLS



HERE IT IS . . . the clinical recording camera. Developed by the Army Signal Corps for the surgeons of the Medical Department, it can "stop" an intricate operation with a silent, built-in flash lasting 1/25,000 of a second!

Best of all, it can take a consecutive stream of stills without interfering with the progress of the surgeons. Successful solutions of unique surgical problems can now be preserved in picture-story form — in color — for medical personnel throughout the Army, and for civilians as well. The importance of this camera to the future of surgery and the saving of lives can hardly be overestimated.

This is but one post-war stride of the new Regular Army. The civilian fields of tomorrow—such as Radar, Nuclear Energy,

Supersonic Aviation, Advanced Electronics, Jet Propulsion — are the fields of *today* in the Army!

Combine exciting opportunities in these fields with the merits of an Army career, and you've an education that's hard to beat. New higher pay, liberal leave and retirement benefits, and the chance to choose your branch of service from those still open (on 3-year enlistments) make this a job you can't afford to miss! See your nearest Army Recruiting Officer for full details.

• Listen to: "Sound Off," "Warriors of Peace," "Voice of the Army," and "Proudly We Hail" on your radio.

**YOUR REGULAR ARMY SERVES THE NATION
AND MANKIND IN WAR AND PEACE**

A GOOD JOB FOR YOU
U. S. Army
CHOOSE THIS
FINE PROFESSION NOW!

UNANIMOUSLY ALL-AMERICAN by FRANK WILLIAMS

DEWITT
"TEX"

COULTER-

...LAST YEAR'S GREAT
ARMY TACKLE...NOW
WITH THE NEW YORK
GIANTS



...PLACED ON EVERY LEADING
1945 ALL-AMERICAN LINE-UP
AFTER HIS FIRST FULL
SEASON AS A REGULAR
...HE WAS RATED AS ONE
OF THE BEST LINEMEN
EVER IN COLLEGIATE
FOOTBALL!

HE FEELS
SHARP!

...DESPITE HIS
225 LBS. "TEX" IS
AMAZINGLY ALERT
AND FAST...

...HIS
SPEED
AND BULK MAKE HIM
ONE OF THE BEST DOWN-
FIELD BLOCKERS IN THE GAME!

HE LOOKS
SHARP!
...AS HE ANTICIPATES ENEMY
PLAYS AND STOPS THEM WITH
UNCANNY PRECISION!

DON'T
ANNOY OUR
BALL
CARRIERS,
SONNY!

look **SHARP**
feel **SHARP**
be **SHARP**

use
Gillette
Blue Blades
with the **SHARPEST** edges
ever honed!

● You look sharp for you enjoy the
swellest shaves ever. You feel sharp
because they're refreshing and give
you a lift. You are sharp for you get
far more shaves per blade and save
money. Ask for Gillette Blue Blades.



5 for
25¢

ENJOY BOXING
FRIDAYS AT
10 PM EST OVER ABC NETWORK. GILLETTE'S CAVALCADE OF
SPORTS ALSO AIRS WORLD SERIES AND OTHER CLASSICS YEAR 'ROUND.

HE IS **SHARP!**

"TEX" GETS THE SMOOTHEST,
MOST REFRESHING SHAVES
A FELLOW CAN HAVE - AND
SAVES MONEY, TOO! YOU'VE
GUESSED IT! HE USES
GILLETTE BLUE BLADES
WITH THE SHARPEST EDGES EVER
HONED... GET HEP MEN--
**DOUBLE EDGES MEAN
DOUBLE ECONOMY!**

Gillette Safety Razor Company, Boston 6, Mass.

Copyright, 1946, by Gillette Safety Razor Company

DEC. 221
1946

Now! The **ONE-UNIT** **HEARING AID**

Thousands Have Waited For

THE NEW **ONE-UNIT**
Beltone
MONO-PAC
HEARING AID

THIS IS
ALL YOU
WEAR

**NO SEPARATE
BATTERY PACK**

NO DANGLING BATTERY CORDS

The tiny new BELTONE Mono-Pac is about $\frac{1}{4}$ size and weight of old-style hearing aids, yet so powerful you hear even *whispers*! Get helpful facts about this new "MIRACLE" aid in valuable FREE book about deafness.

BELTONE HEARING AID CO.
1450 W. 19th St., Chicago 8, Ill.

FREE BOOKLET

Beltone Hearing Aid Co.
Dept. PS-12, 1450 W. 19th St., Chicago 8, Ill.
Please send me FREE booklet about deafness and what can be done to overcome it.

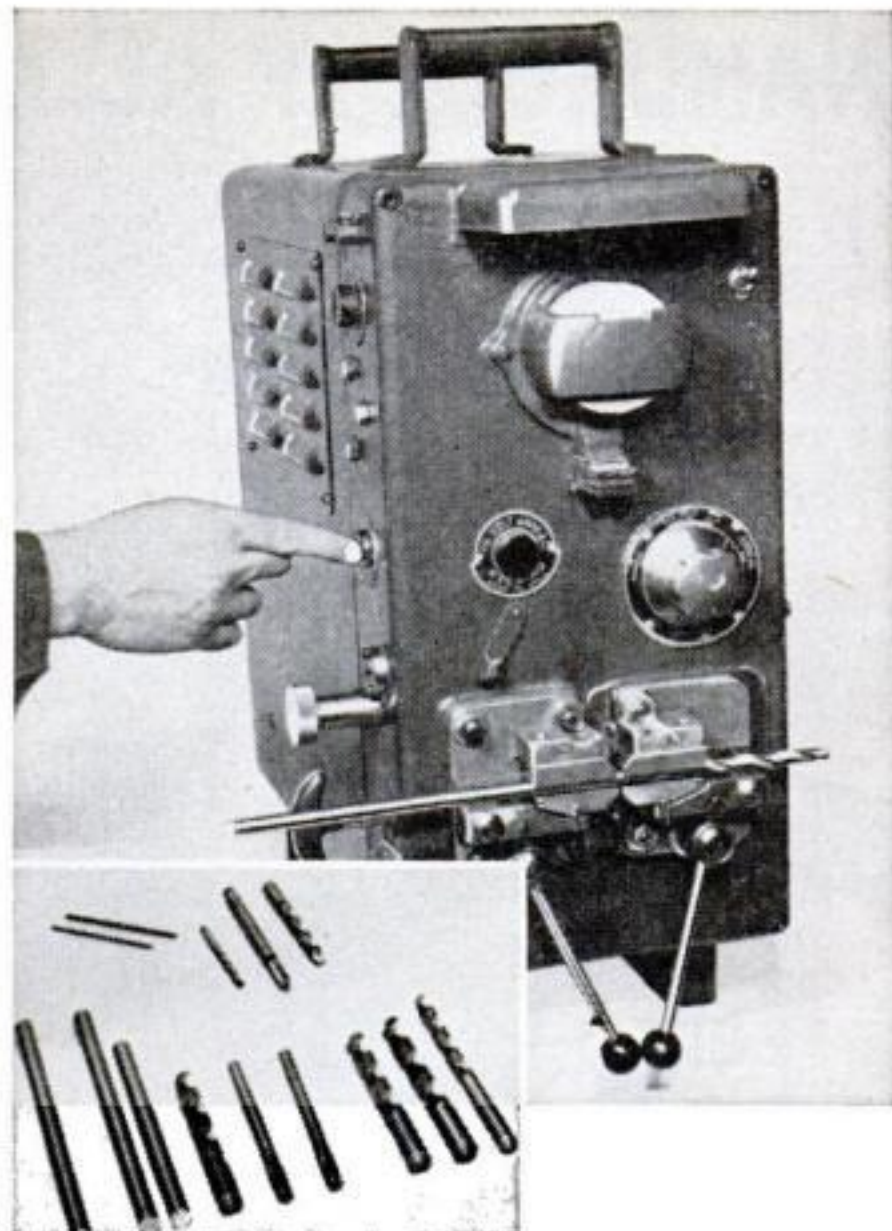
Name _____

Address _____

Town _____

Zone _____

State _____



Portable Flash Butt Welder

A PORTABLE, automatic welder produced by the DoAll Co., of Minneapolis, is designed for production welding of bar and round stock up to $\frac{5}{16}$ " diameter. Its uses include the repair of small tools and welding of tool-bit extensions. The entire welding cycle is controlled by a single push button. Other special features include a built-in grinder and an automatic motor to control the feed of materials. An etching attachment provides a means of permanently identifying tools, dies, and fixtures. The model is designed for standard AC 220-volt operation, but it can be supplied for other voltage requirements.



**Model Builders
Attention!**

Actual Size V-Plug

Champion spark plugs for model gas engines give the same dependable performance as regular Champions. Sillment sealed. Sillimanite insulator. Alloy needlepoint electrodes for easy starting. One piece construction.

	V	V-2	V-3
Hex	$\frac{1}{2}$ "	$\frac{3}{8}$ "	$\frac{5}{16}$ "
Thread	$\frac{3}{8}$ "-24	$\frac{1}{4}$ "-32	$\frac{1}{4}$ "-32
Thread Length	$\frac{7}{32}$	$\frac{7}{32}$	$\frac{5}{32}$
Weight, Grams	8	$3\frac{1}{2}$	$2\frac{1}{2}$

CHAMPION

SPARK PLUG COMPANY • TOLEDO 1, OHIO



PREPARE your car for winter driving by having your dealer check your spark plugs now. If they have lost their efficiency, insist on new Champion Spark Plugs. They will insure instant starts in coldest weather, faster warm-ups and smoother engine performance. Champion dealers everywhere will serve you with the correct size and type for your car to insure maximum efficiency and economy. Snap into winter with dependable Champion Spark Plugs.



Snap into winter...



with dependable
CHAMPION
SPARK PLUGS

FOLLOW THE EXPERTS

DEMAND DEPENDABLE CHAMPIONS FOR YOUR CAR

DEC. 1946 223

**BUILD YOUR OWN
RADIO AND ELECTRONICS DEVICES
AT LOW COST**

Our **BIG BARGAIN COUNTERS** display new parts and unusual special equipment you'll enjoy seeing. Come in, look around, ask questions . . . it's fun.

Public address systems for every need and purpose.

with **NEWARK'S KITS AND PARTS**

You Can Easily Build Radio Receivers and Transmitters—Record Players and Other Exciting Radio and Electronics Devices.

Make a good radio receiver or fine record player at big savings. You can build these and many other things easily. In any of our stores our staff will gladly show you how—or will explain clearly by mail. **Write for our famous Big Bargain Bulletins**, listing all the newest things available. Send for it today. When writing, address Dept. B3.

NEW YORK

242-50 W. 55th St.
New York 19, N. Y.

NEWARK
ELECTRIC COMPANY, INC.

CHICAGO

323 W. Madison St.
Chicago 6, Ill.

N.Y.C. Stores: 115 W. 45th & 212 Fulton St.
Offices & Warehouse: 242 W. 55th St., N. Y. 19

NOW YOU CAN OWN
A FAMOUS

★ **ORIS** ★
WATERPROOF WATCH

An unusual limited offer—lowest price we ever sold an ORIS 7-jewel pin-lever time piece. Chrome top, stainless steel back—modern stainless steel expansion watch bracelet included.

SHOCK RESISTANT!
NON-MAGNETIC!
RADIUM DIAL!
SWEEP SECOND HAND!

\$18.65 with steel
Only expansion bracelet

Fed. Tax Included

Write for free illustrated booklet



Mail orders
promptly filled
No C.O.D.'s
Postage Prepaid

LAMONT

Internationally Famous Watches

SUITE 1006 • 597 FIFTH AVE. • NEW YORK 17

We met in the Army



now I demand

Over 90 million yards of Reeves Army Twill were purchased by Uncle Sam during the war. It has great tensile strength—resists tearing, snagging and scuffing. Its dyes are fast to sun, water and perspiration. Sanforized Shrink*, it tailors smartly, holds its lines. It comes in a wide variety of colors. Demand Reeves Army Twill for better, more economical work clothes.
*Residual shrinkage less than 1%.

REEVES BROTHERS, INC.
54 Worth Street, New York 13, N. Y.

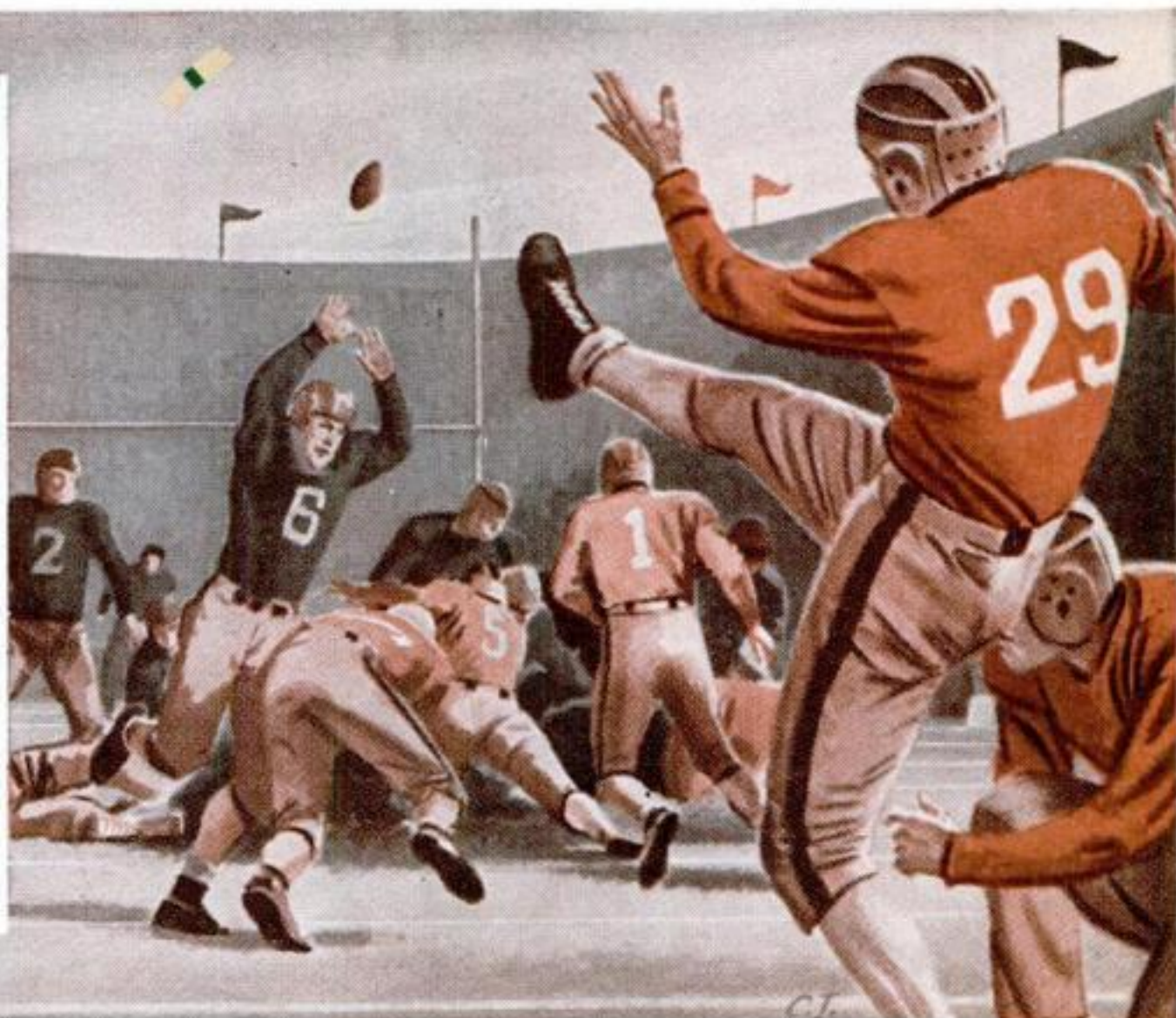


NEW


"EVEREADY" FLASHLIGHT BATTERY LASTS 93% LONGER!

Tiny cell packs
enough ENERGY to
kick 186 field goals

Like football? Like to sit breathless while the Big Team goes into kick formation for a last-minute try? Then here's news: The great new "Eveready" flashlight cell NOW has energy equal to that used in making 186 big-time field goals from the 25-yard line! Extra power makes "EVEREADY" batteries the All-American choice for brilliant, lasting, low-cost light!



THE NEW "Eveready" flashlight cell literally *blasts* darkness with a dazzling beam of powerful white light. And does it for nearly *twice* as long as famous pre-war "Eveready" batteries. Because this new cell packs 93% *more energy*! Service from "Eveready" flashlight batteries is nearly *doubled*...yet you *pay no more* for this far greater value! For longer life of brighter light... get these new "Eveready" flashlight batteries!

The registered trade-mark "Eveready" distinguishes products of
NATIONAL CARBON COMPANY, INC.
30 East 42nd Street, New York 17, N. Y.
Unit of Union Carbide  and Carbon Corporation

Nearly *twice* the electric energy... almost *two times longer life* of brilliant white light than even famous pre-war "Eveready" batteries...at no extra cost. That's today's *high-energy* "Eveready" battery, as proved by the "Light Industrial Flashlight" test devised by the American Standards Association.

93% MORE ENERGY
1946

1941



High Energy

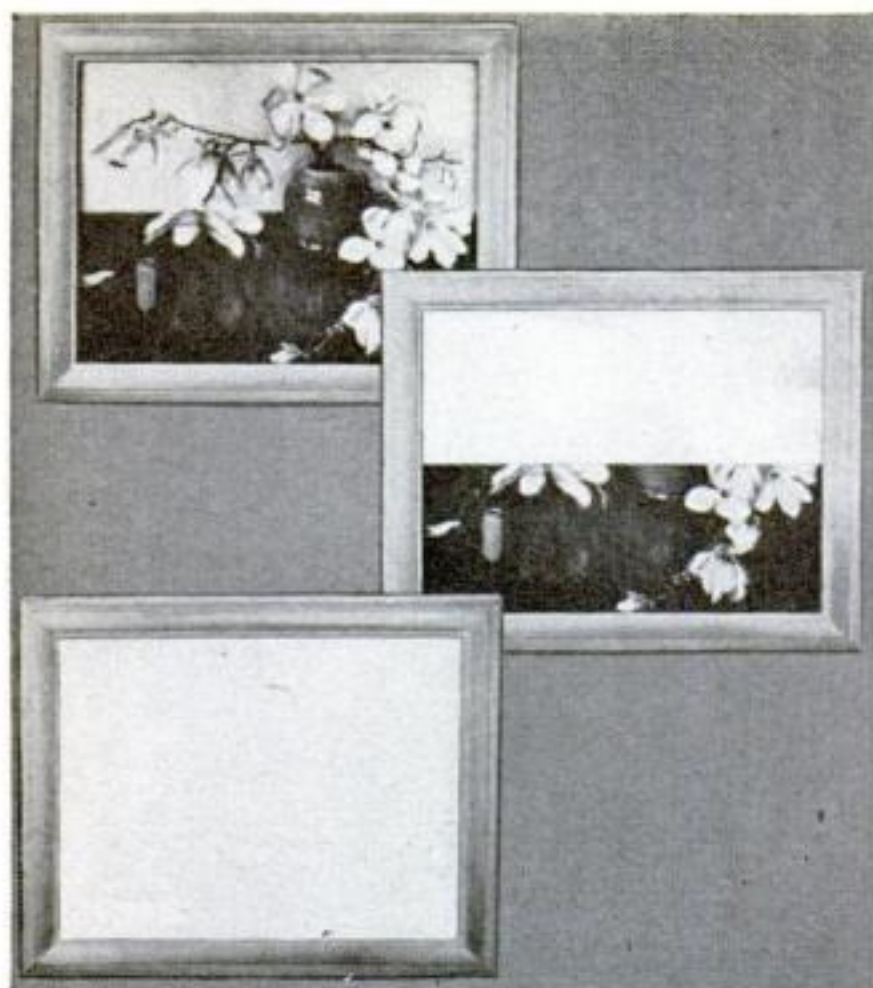
MEANS

BRIGHTER LIGHT, LONGER LIFE

EVEREADY
TRADE-MARK
FLASHLIGHT BATTERIES

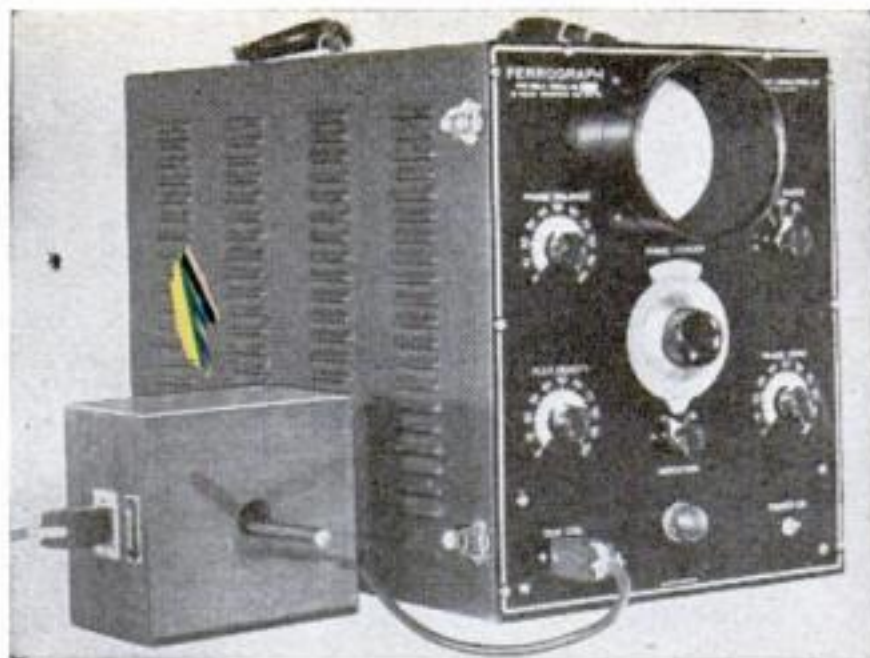


DEC. 1946 225



Concealed Projection Screen

A HOME projection screen that is in effect an oil-painting reproduction when not in use has been developed by the Radiant Mfg. Corp., of Chicago. The screen, of glass-beaded material, is concealed in the upper part of the frame.



Magnetic Metal Analyzer

USING the relationship between magnetic and metallurgical properties, the Ferrograph speedily determines the composition of ferromagnetic materials by electrical analysis. Developed by the Allen B. Du Mont Laboratories, of Passaic, N. J., it has a cathode-ray indicator that permits examination of the induced voltage in the secondary of a transformer in which the sample under test is the core. The apparatus simplifies industrial tests by unskilled workers, who have only to compare the machine's indication with known values.

The first pipe smoke!



Sir Walter Raleigh, father of pipe smoking, never knew the pleasures of a Sterncrest pipe. Poor chap, he was born too soon to puff an LHS of genuine Imported Briar, vita-fused for sweetness from the first puff.

IMPORTED BRIAR
Model #14 \$5

Dozens of others—antique or smooth finish.

LHS STERNCREST 14K, with gold band, imported briar \$7.50

Other LHS Pipes: \$25, \$10, \$3.50, \$1.50. at all good dealers

The best pipe smoke!



Write for "Pipes—for a World of Pleasure." It's FREE L & H STERN, INC., 56 Pearl St., Brooklyn 1, N.Y.



STERNCREST
STERLING

ZEUS Filter Cigarette Holder is back in Aluminum.

Atlas—the compact, low-cost MILLER for tool rooms, production, commercial & home shops

Atlas—the compact, low-cost MILLER for tool rooms, production, commercial, and home shops.

Precision built . . . engineered for quick set-ups over a wide work range . . . the rugged, versatile Atlas miller greatly increases the scope of your shop. It handles all operations from slabbing and facing cuts to end milling, keyways, finishing, and layout work. Table travels 10" horizontally, 3½" cross, 6" vertically, spindle speeds from 62 to 2870 RPM provide correct range for all types of work and cutters. Back geared power, complete V-belt drive, Timken bearings. Operates from ⅓ HP motor. Available now for fairly prompt delivery. See your Atlas distributor.

SEND FOR
FREE CATALOG



ATLAS PRESS CO.

1255 N. PITCHER ST.

KALAMAZOO 13, MICH.



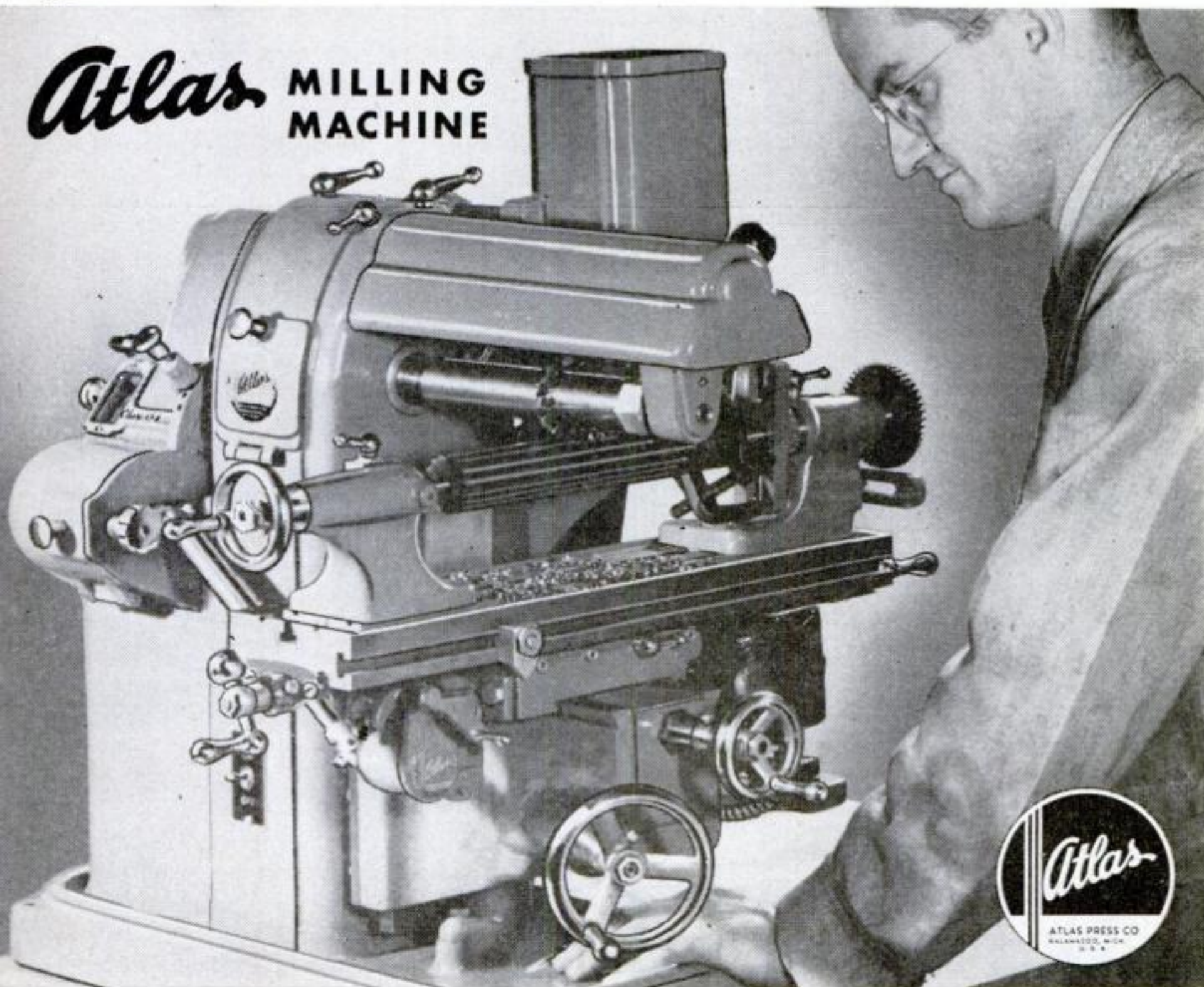
LATHES

DRILL PRESSES

MILLING MACHINES

SHAPERS

Atlas 4 TOOL TEAM



DEC. 1946 227

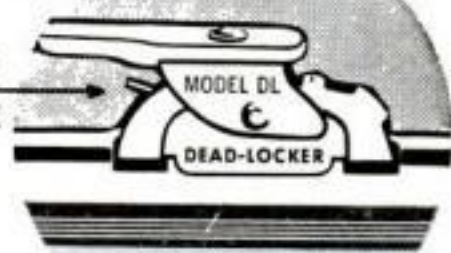
ANCO RAIN-MASTER

"Dead-Locker"

WINDSHIELD WIPER
ARMS and BLADES

BLADE SNAPS ON...
STAYS PUT

FINGER-
TIP
RELEASE



CAN'T FALL OFF
CAN'T BLOW OFF

(A war-born invention—by ANCO—first)
(for military aircraft—now for your car.)

DON'T SHOOT YOUR GAS-PUMP MAN!

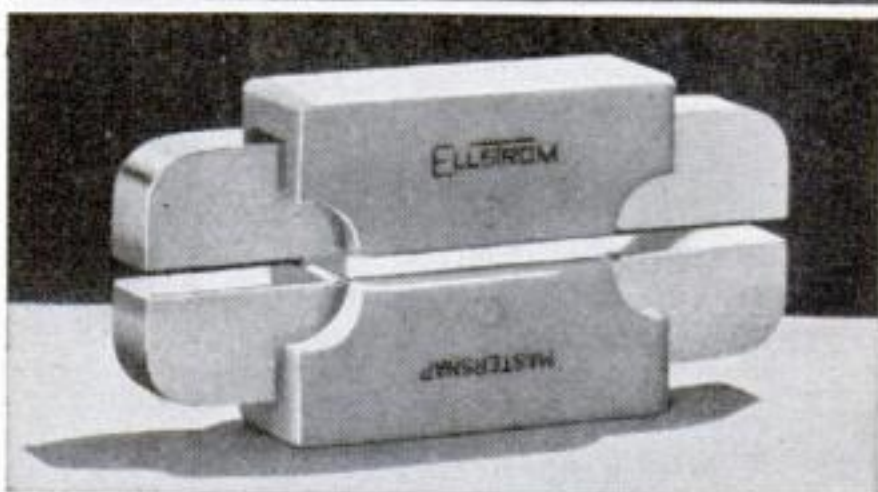
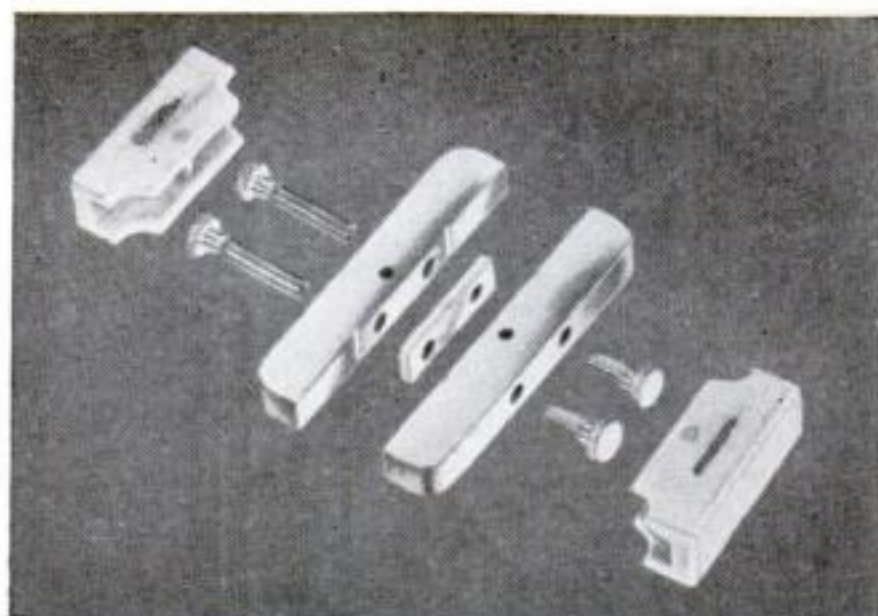
He's doing the best he can. Sure, he knows how dangerous it is for you to drive your car... in stormy weather... with your dull old windshield wipers that smear and smear. He'd gladly put on for you quickly a pair of keen new ANCO RAIN-MASTER Wiper Blades and Arms. He has them—Newest Models! But he forgets to remind you? Too busy? You can't shoot him for that!



After all, it's *your* car to protect. So *you* remind *him*. Get RAIN-MASTERS... patented features... original equipment on many makes of high grade cars and trucks... used in war—on our fighting tanks and trucks and ships and bombers too... because ANCO RAIN-MASTERS clean quicker, clean cleaner... last longer. May save you a costly smashup.

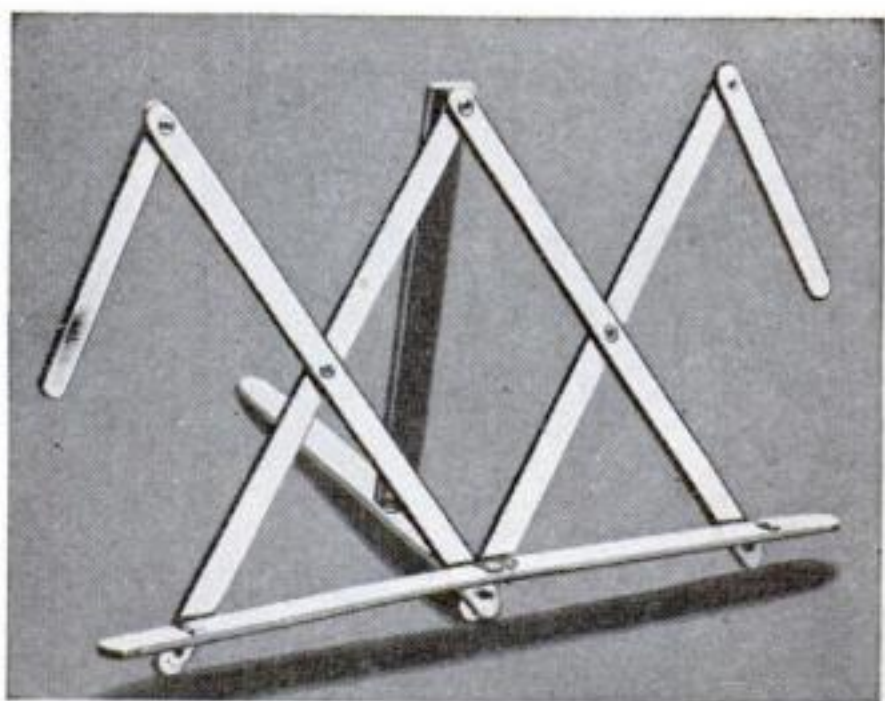
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Arms and Blades next time you buy gas.

THE ANDERSON COMPANY
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Gauge Has Nonwearing Blocks

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Pocket-Size Folding Stand

For musicians, stenographers, or anyone else who needs something to prop papers against, the J. B. Steven Products Co., of New York City, has designed the Handi-Stand, a compact rack of lightweight magnesium. Folded, it fits a pocket.

BETTER BY FAR

in Construction



You'd know what we mean if you could watch one of these Fisher Bodies come down the assembly line.

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Your eyes tell you the new bodies by Fisher are beautiful when you see them on the road. And your knowledge of good craftsmanship will tell you they're "better by far" through and through, and that cars with Body by Fisher are well worth waiting for.

1 TURRET TOP, pioneered by Fisher Body, is formed of a single sheet of solid steel.

2 U-SHAPED STEEL ROOF BOWS are fused to the steel roof rails, affording extra ruggedness and shock resistance.

3 STEEL COWL AND DASH, ruggedly braced with a triangular truss construction, provide solid support for the front door hinge pillar.

4 Outer and inner DOOR PANELS are welded into one solid unit.

5 SOLID STEEL FLOOR, especially ribbed for extra strength, forms the foundation of the Unisteel Turret Top Body by Fisher.

6 BOX-TYPE REAR END BRACES give extra protection against weaving and twisting.

PLUS a long list of other features in design and construction, which would total more than a hundred.

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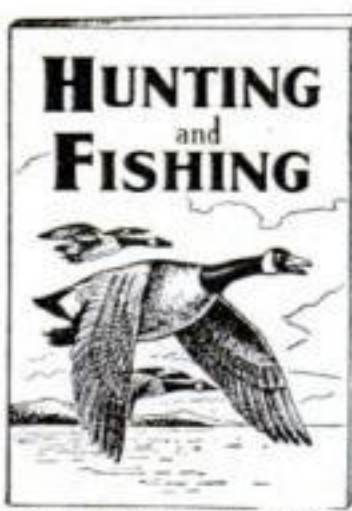
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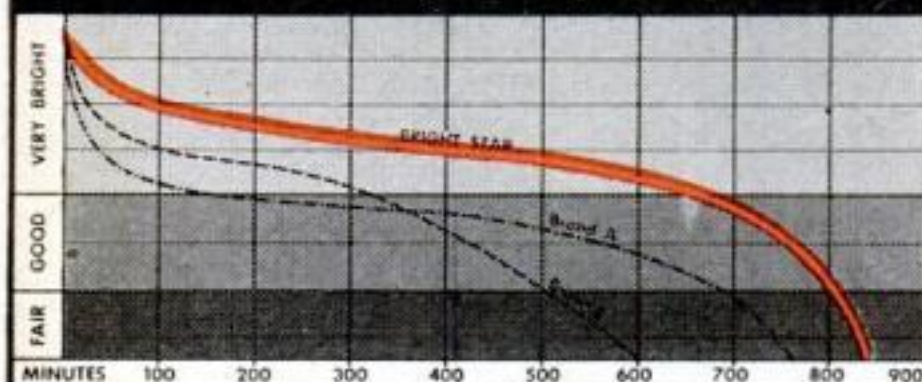
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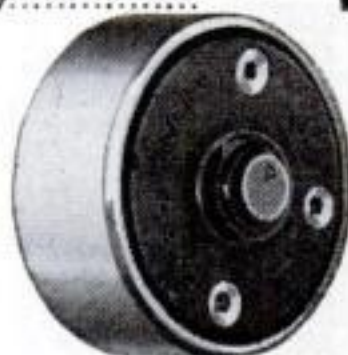


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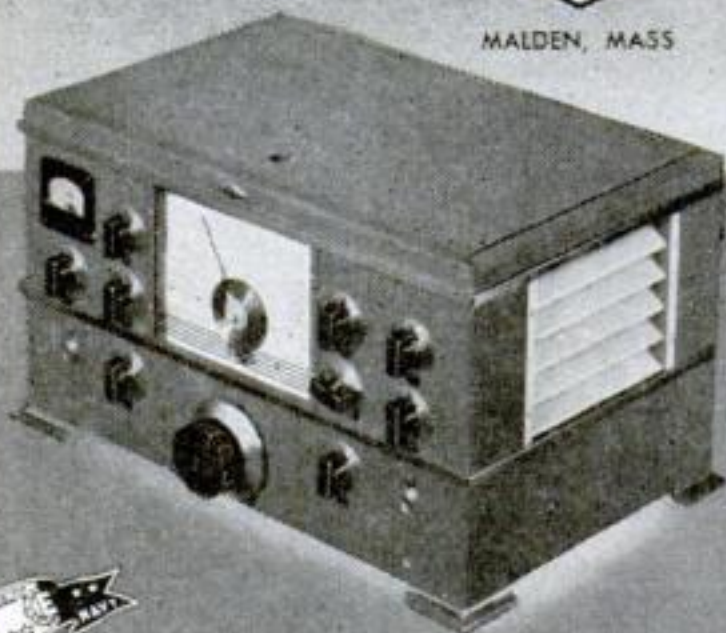
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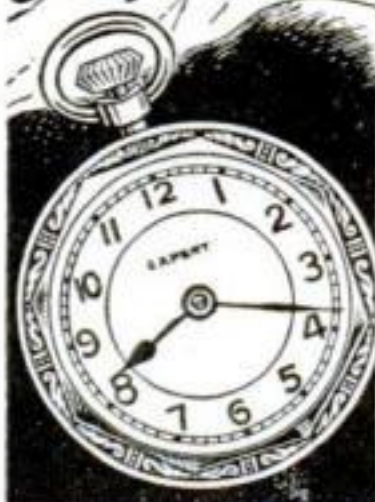
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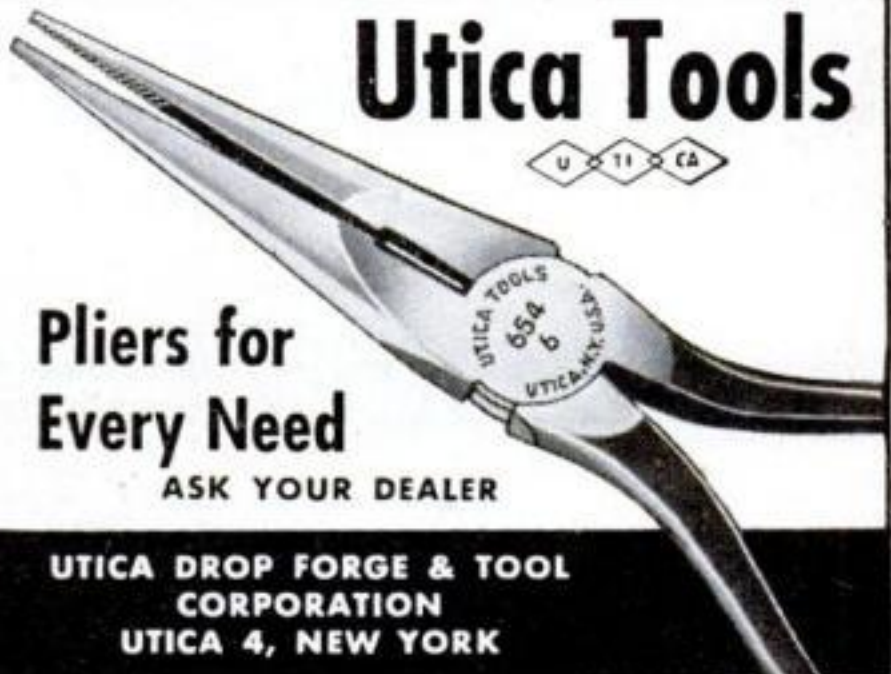
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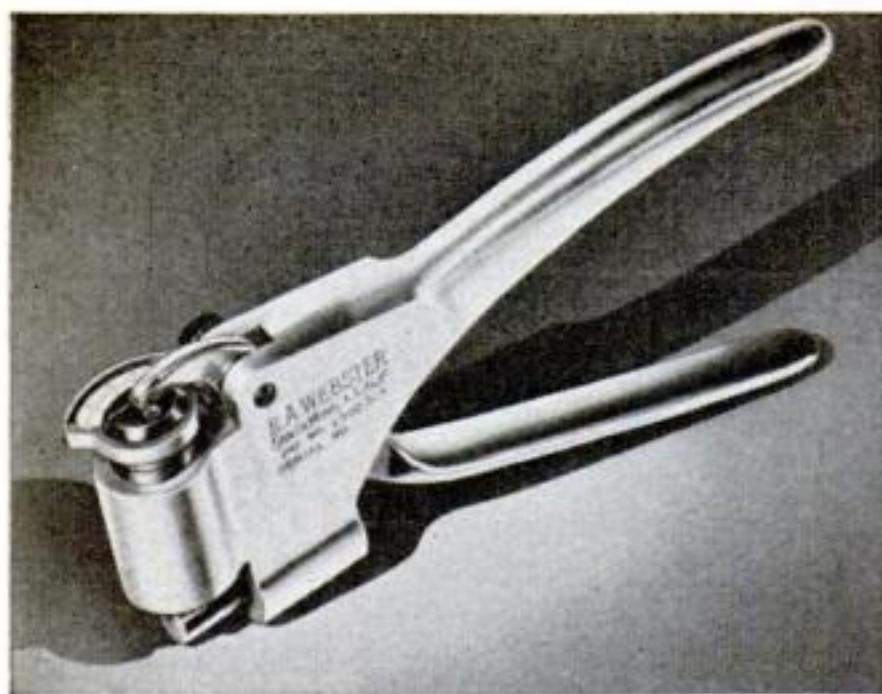
Name _____

Address _____

Size and width of Shoe _____

PS-12

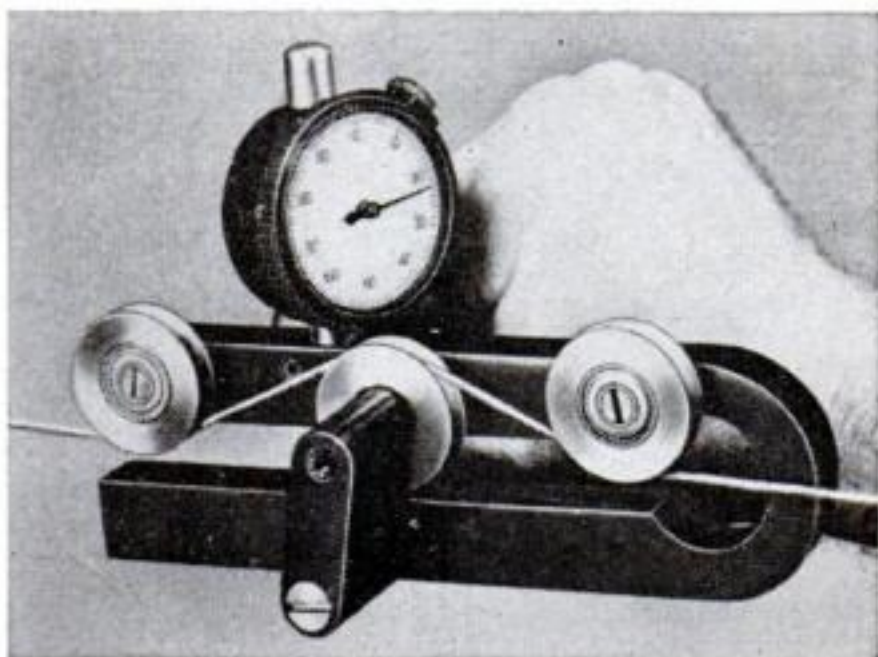
DEC. 1946 239



Hand Metal-Hardness Gauge

A NEW hand-operated, portable gauge for determining variations in the hardness of aluminum and its alloys, and another for testing copper, brass and other nonferrous metals, are introduced by R. A. Webster, a Santa Monica, Calif., company. The instruments look and operate alike. Squeezing the handles actuates a penetrator, and a meter shows the hardness of the material being tested. The penetrator's real pressure is applied by a spring load unrelated to the pressure put on the grips of the

gauge, assuring consistent readings. Both models are equipped with cylindrical anvils that allow testing of strips, sheets, tubes or extrusions with a single tool.



Tests Tension of Textiles

FOR testing the tensile strength of cord, yarn or thread up to 100 pounds, Walter Kidde & Co., Belleville, N. J., has devised the "tensometer" shown above. The instrument can be clipped onto moving, continuous textile filaments and measures tension directly in pounds.



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240 POPULAR
SCIENCE

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TO RUN A
MINIATURE RAILROAD



IT'S A GRAND FEELING, TOO,
WHEN YOUR CAR IS
CUSHIONED WITH MARFAK
CHASSIS LUBRICATION

Miniature railroading is fun, with remote controls, realistic whistles, and real smoke. And a smooth riding car is lots of fun, too.

That "cushioned" ride you feel when your car is lubricated with *Marfak* is evidence that *Marfak* is doing its job . . . is furnishing a lubricating cushion for your vital chassis bearings. And *Marfak* lubricates for longer, too, a thousand miles and more.

It's because *Marfak* is scientifically designed to do its job . . . its special adhesive and cohesive qualities resist wash-out, jar-out, and squeeze-out. *Marfak* clings to the bearing surfaces . . . sealing out dirt and grime.

Yes, it's a grand feeling when your car is "cushioned" with *Marfak* chassis lubricant. See your Texaco Man today, and say: "*Marfak*, please."



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TUNE IN: TEXACO STAR THEATRE presents the new Eddie Bracken show every Sunday night. METROPOLITAN OPERA broadcasts every Saturday afternoon. See newspapers for time and stations.

DEC.
1946 241



2 Handy Sizes Packed
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**PRESSURE LOCK
WRENCH**

..actually Six Tools in One!

It will save his temper . . . improve his skill . . . greatly increase his enjoyment of putting around the house, hobby shop, motor boat, car or plane. If he's a worker on the farm, in the shop or factory, he can't afford to be without a set.

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An exclusive, patented device keeps the jaws parallel when they close. Prevents rounding of nuts, slipping and accidents . . . assures even pressure and a firm grip to the very tip of the jaws.

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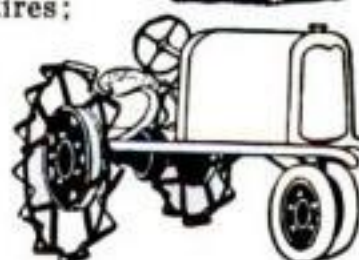
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At better shops in a full range of shapes, individually boxed.

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Sterling Hall, Hand Made, \$5.00
Sterling Hall, Highest Grade, \$7.50

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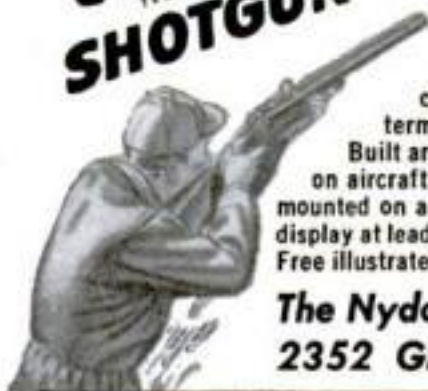


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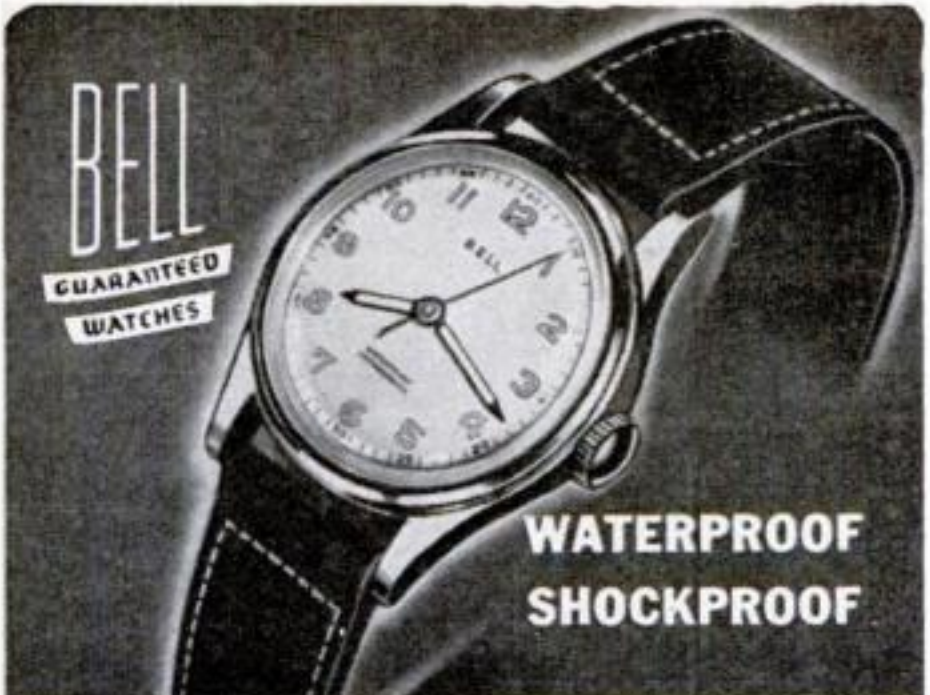
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for sustained accuracy.
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within .0005" of parallelism.
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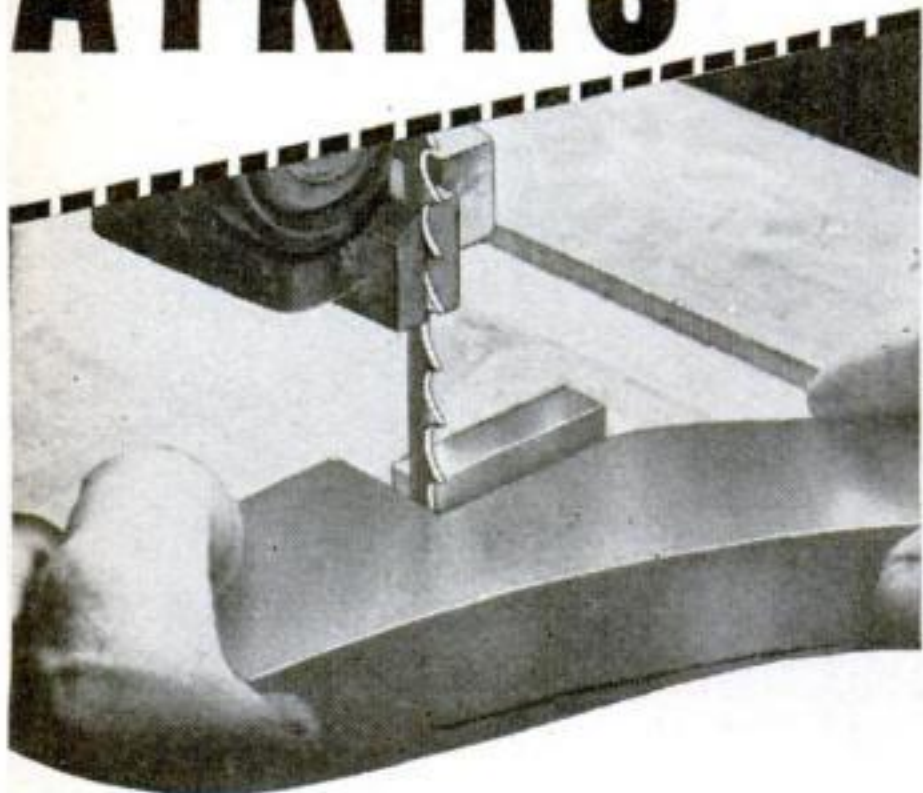
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Featuring this Powerful
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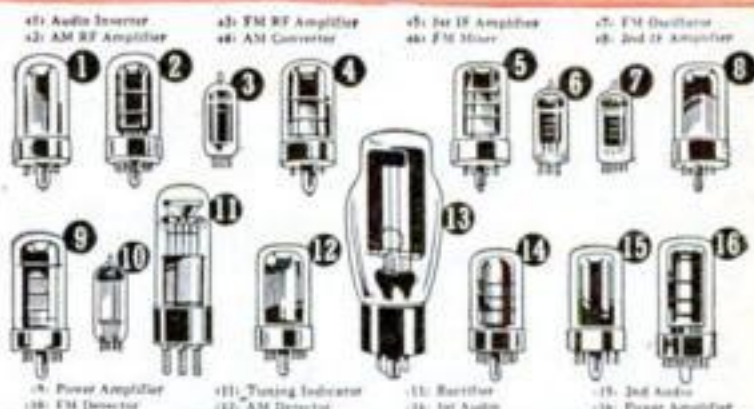
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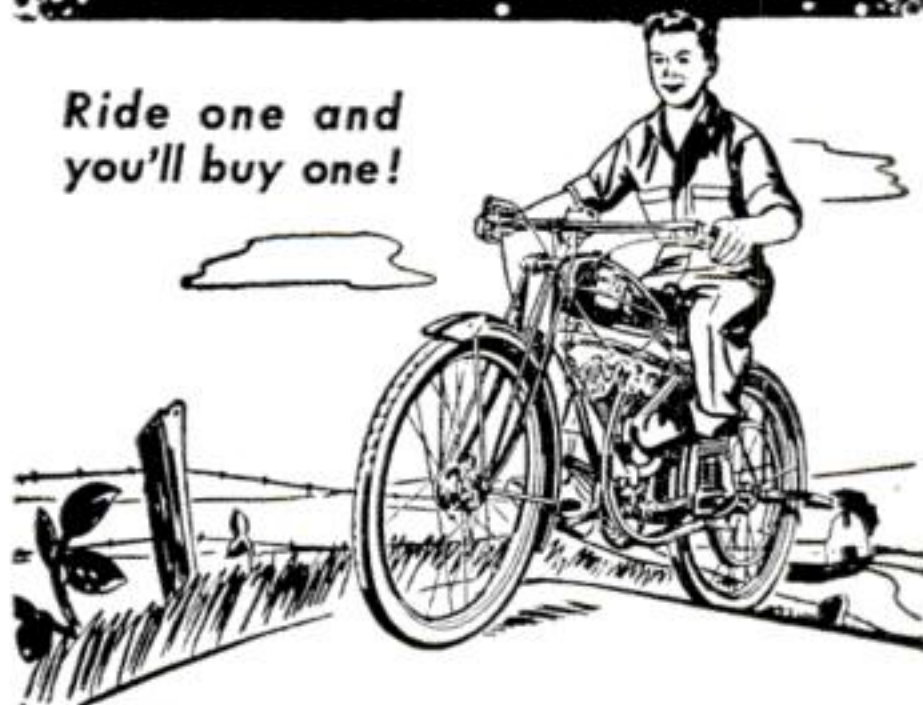
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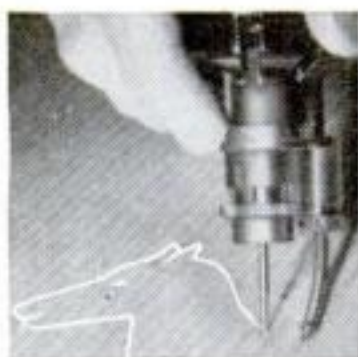
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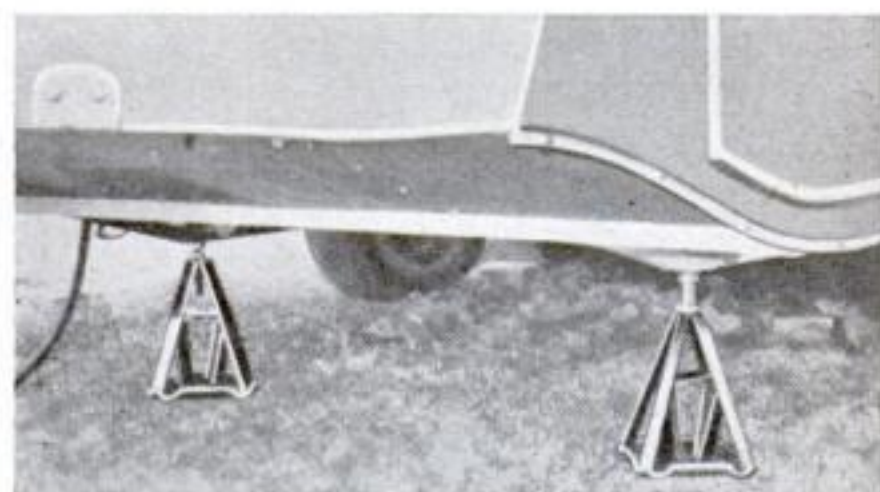
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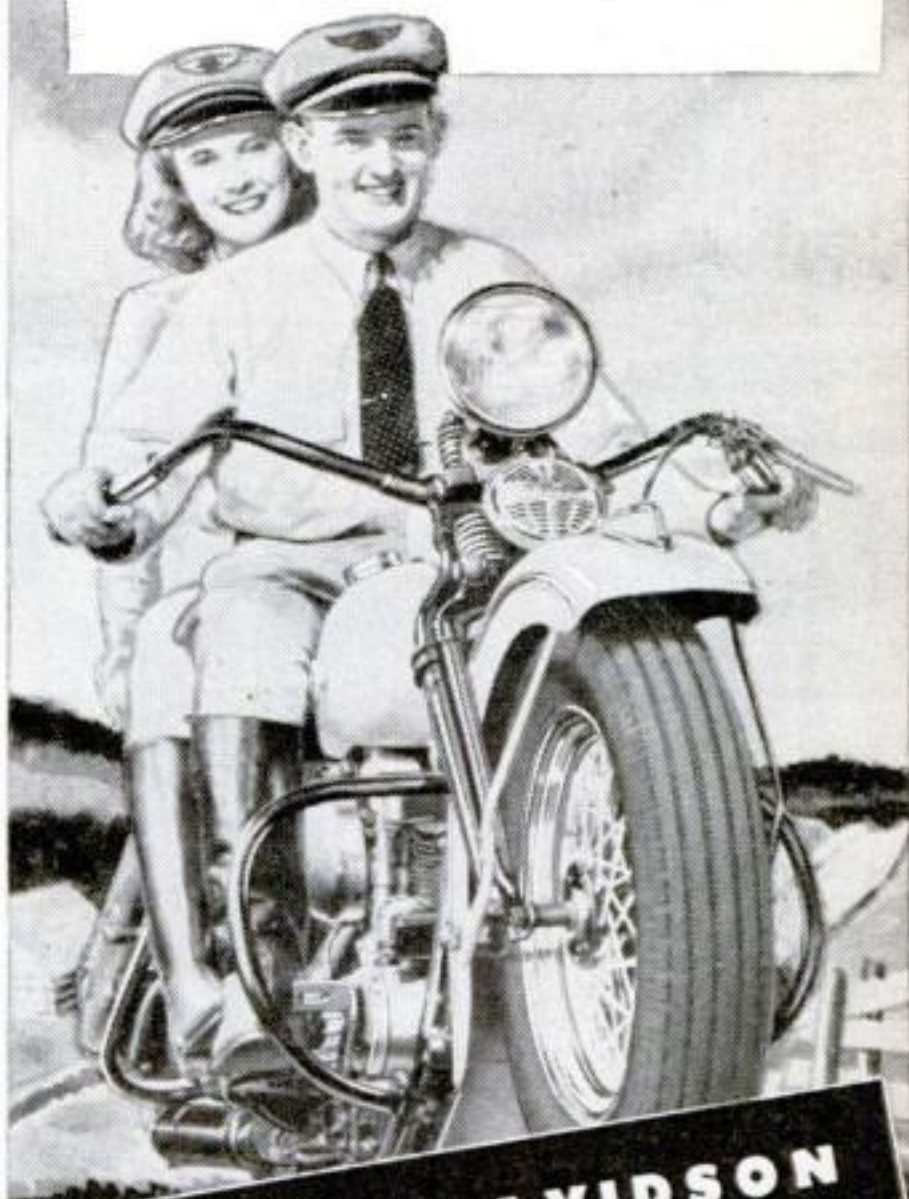
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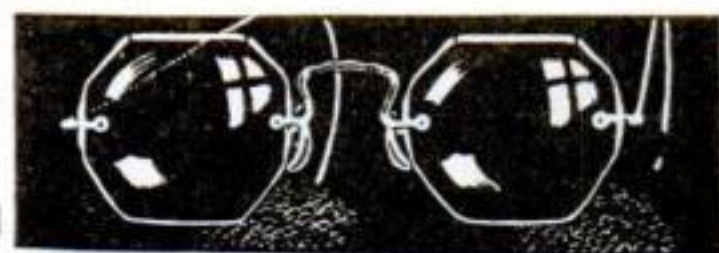
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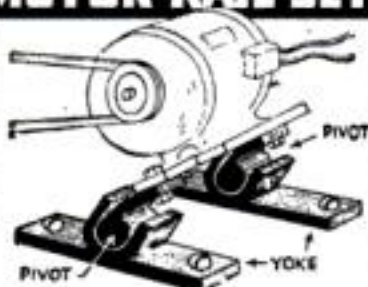
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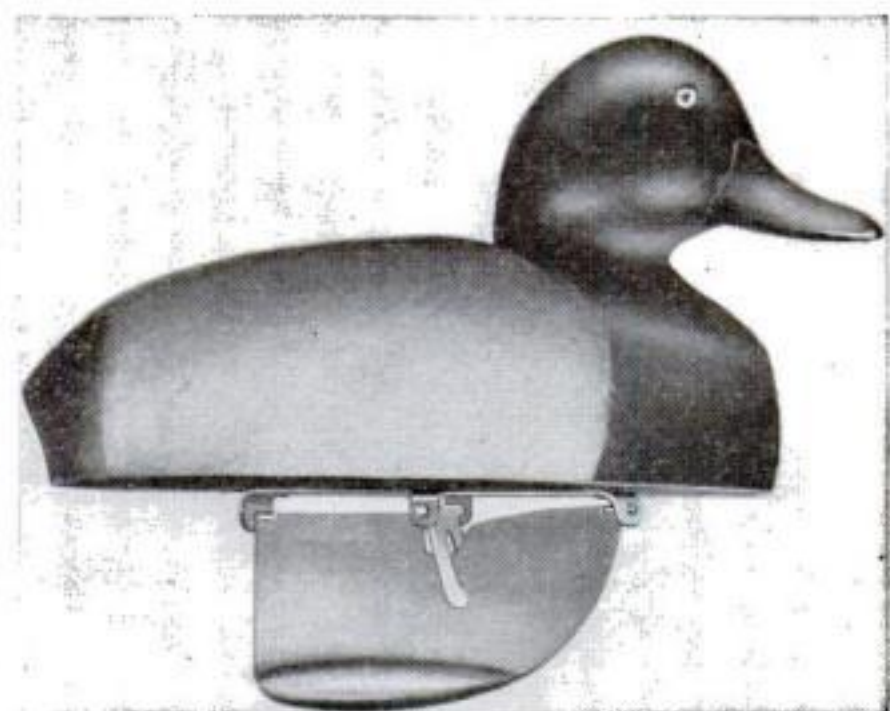
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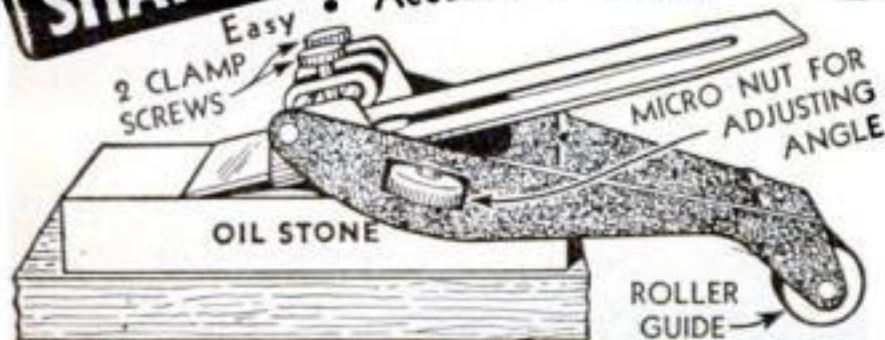
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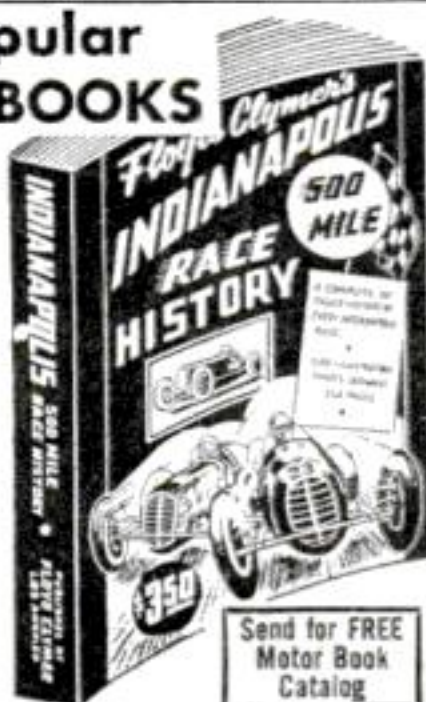
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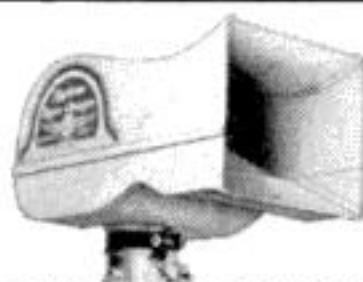
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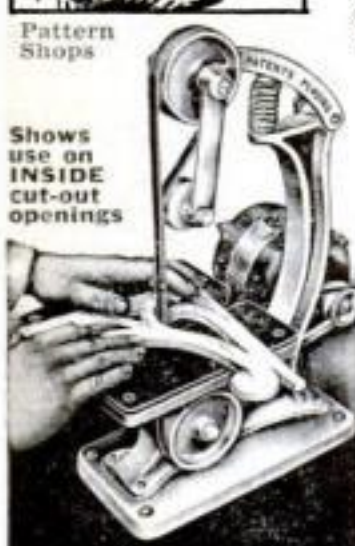
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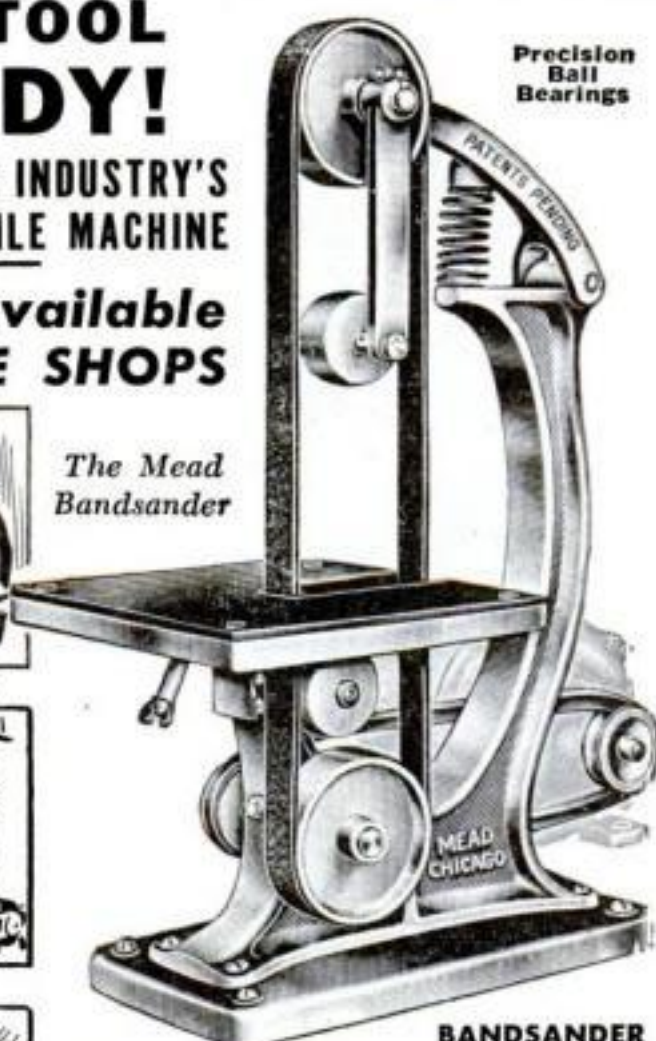


Pattern Shops



Shows use on
INSIDE
cut-out
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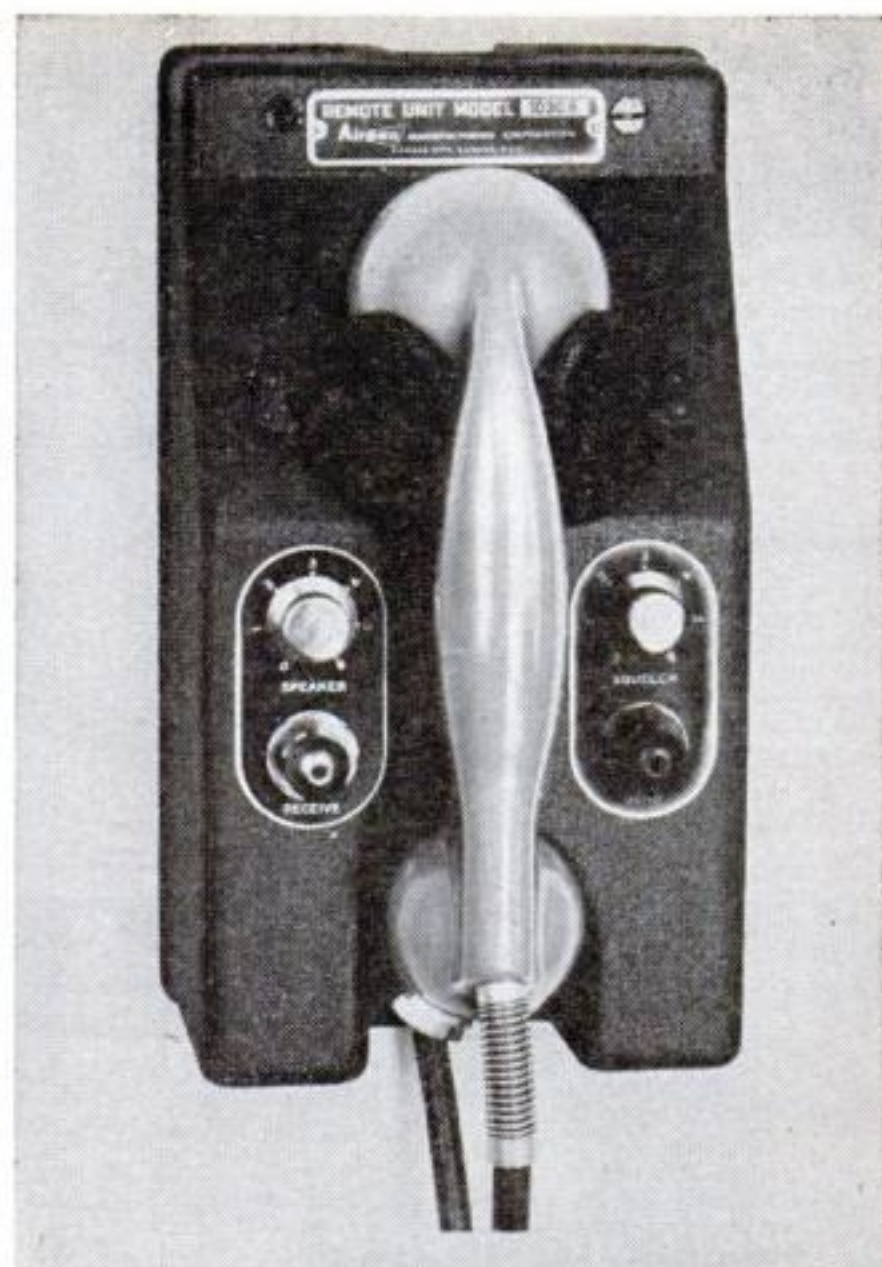
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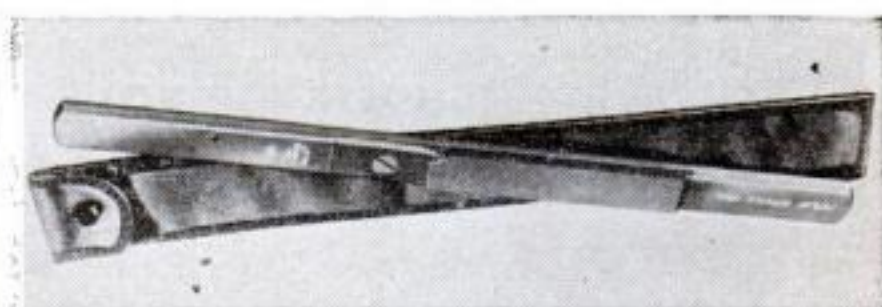
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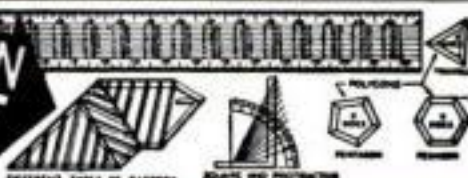
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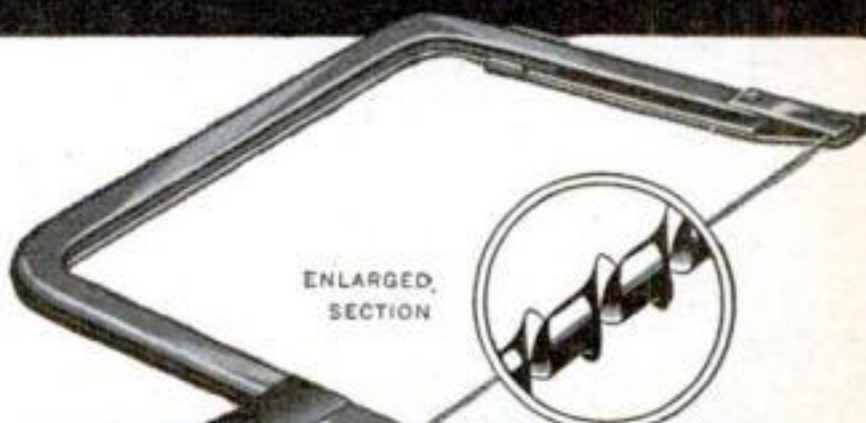
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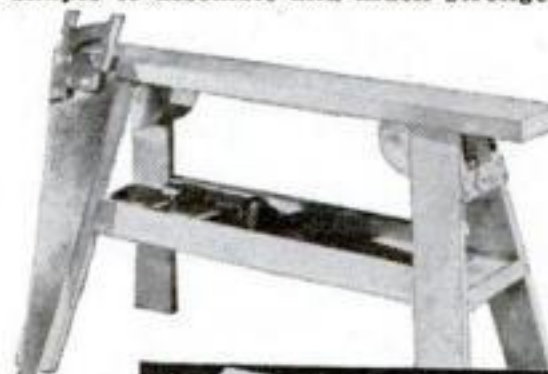
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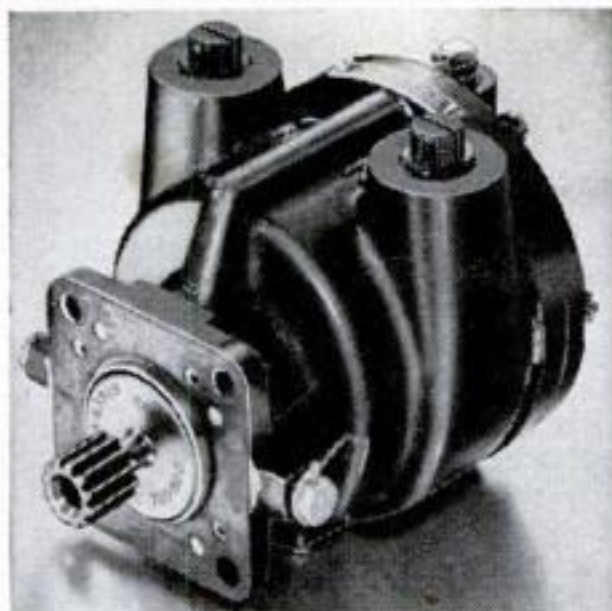
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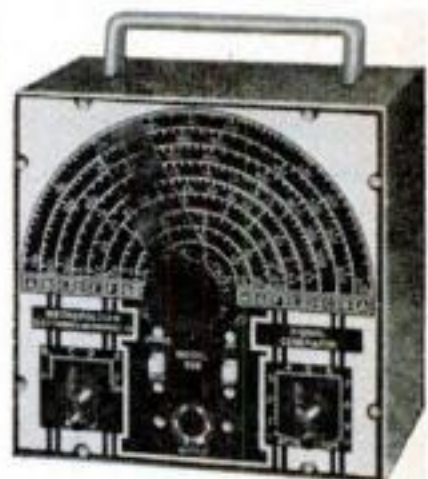
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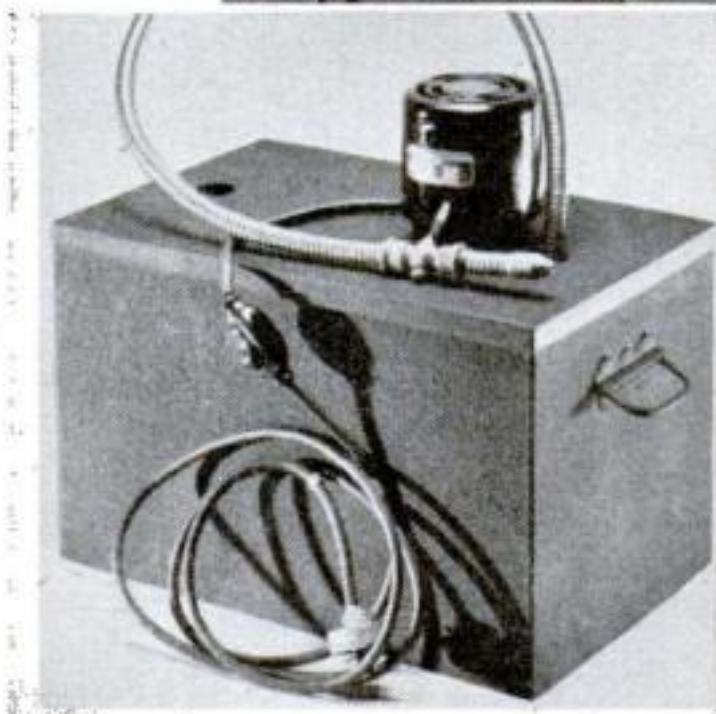
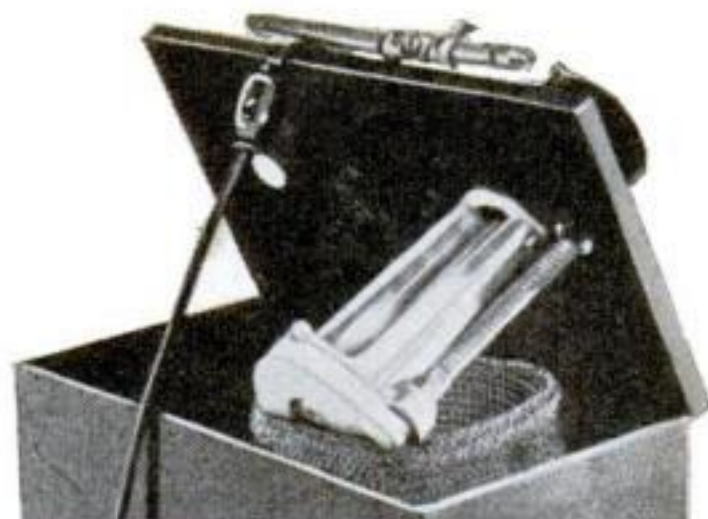
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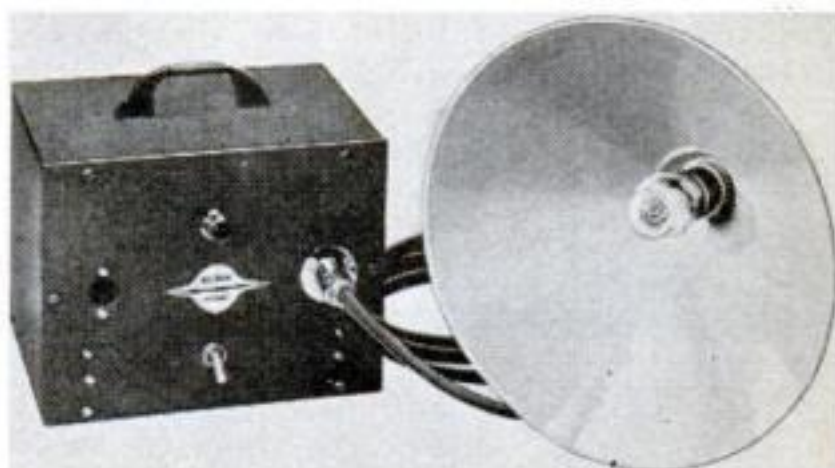
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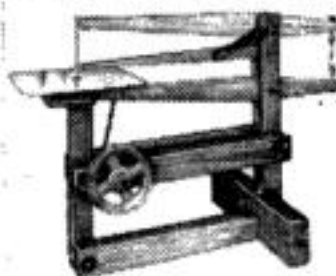
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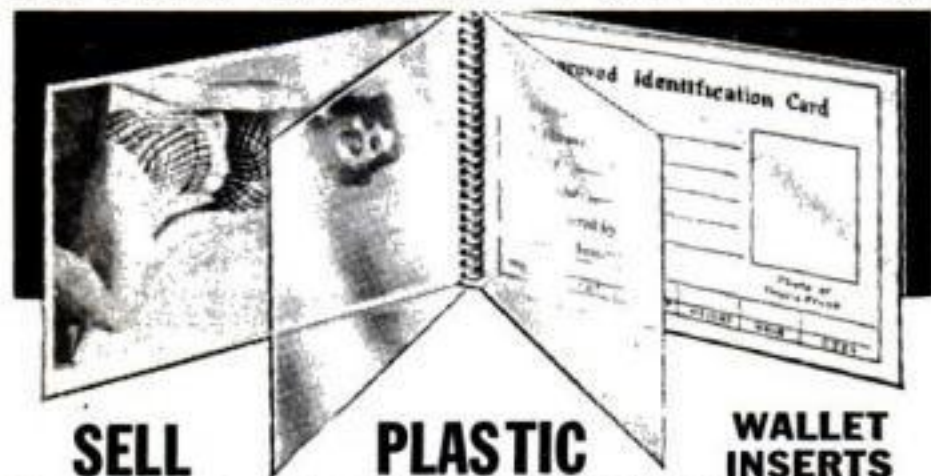
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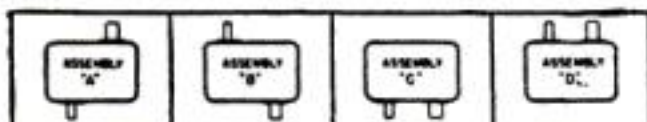
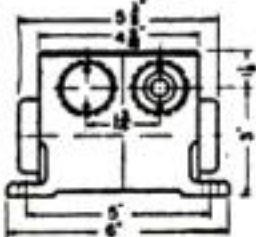
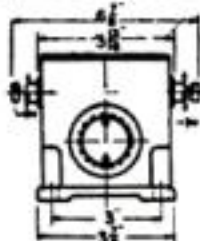
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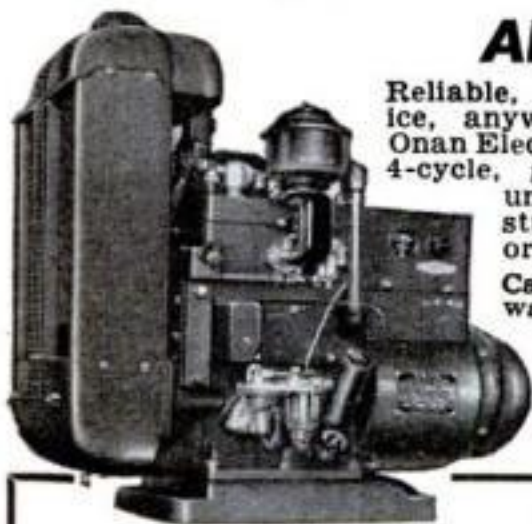
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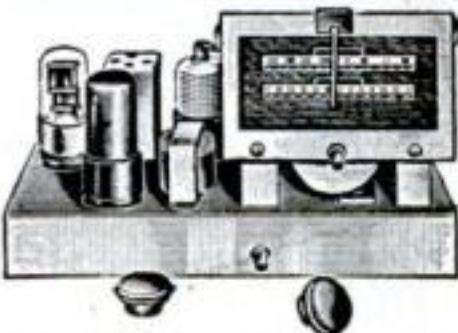
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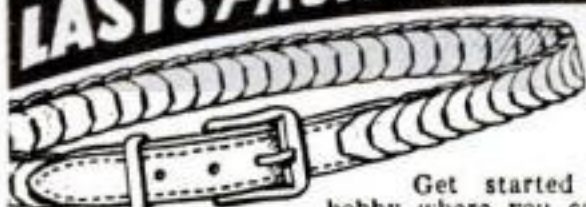
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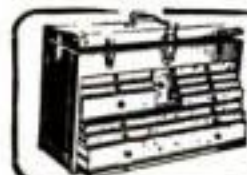
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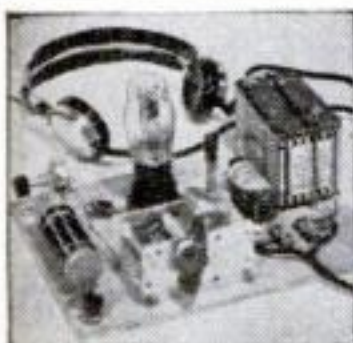
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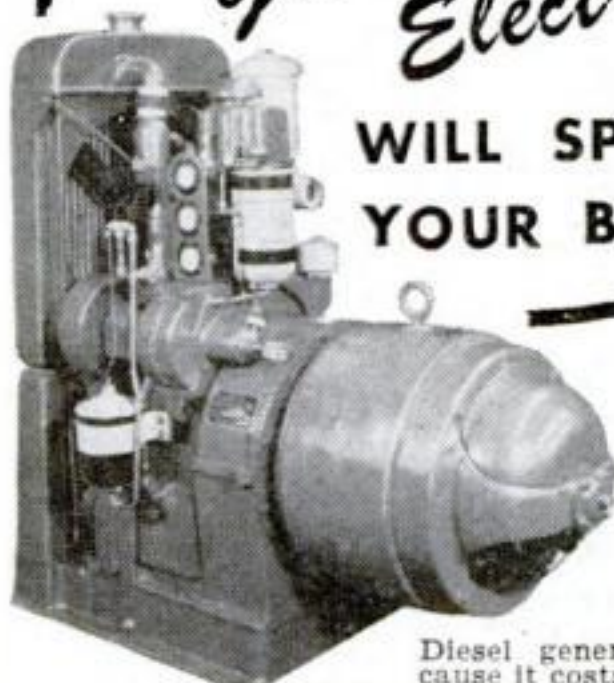


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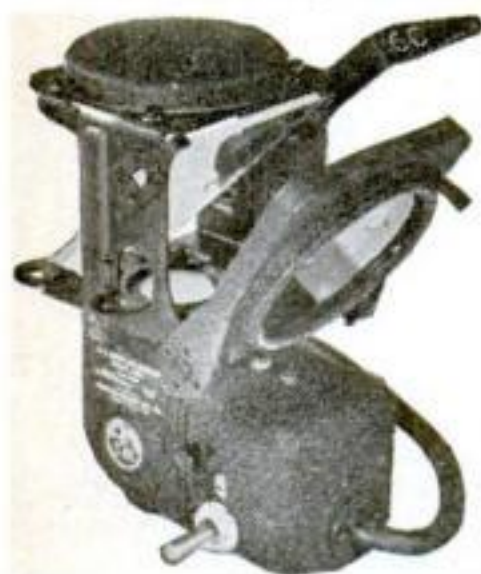
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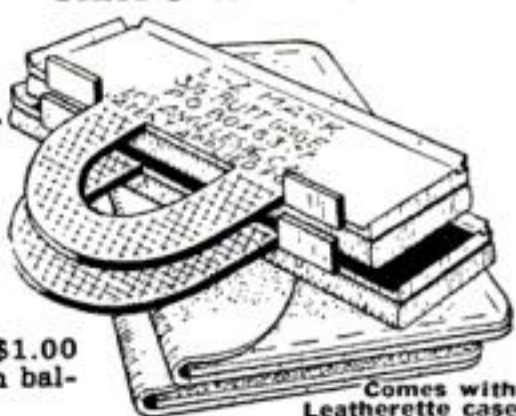
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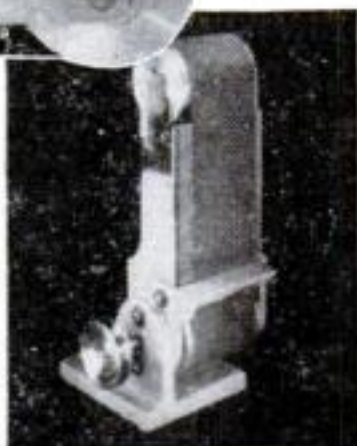


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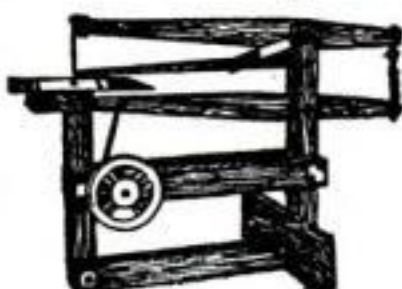
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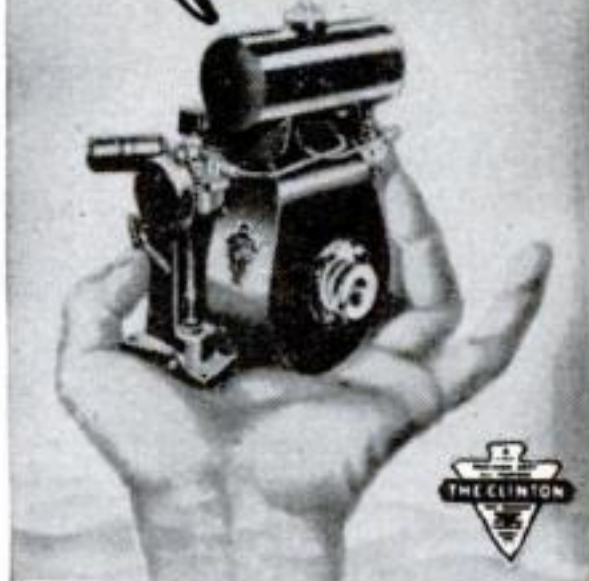
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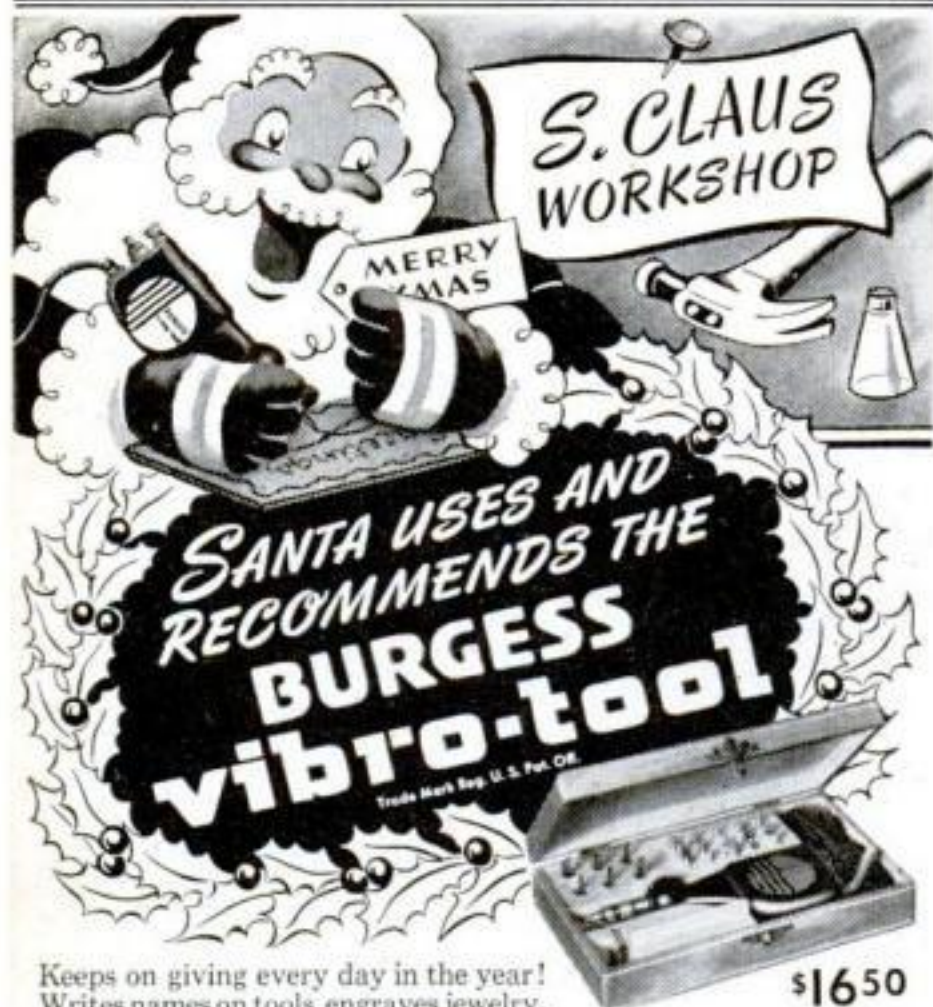
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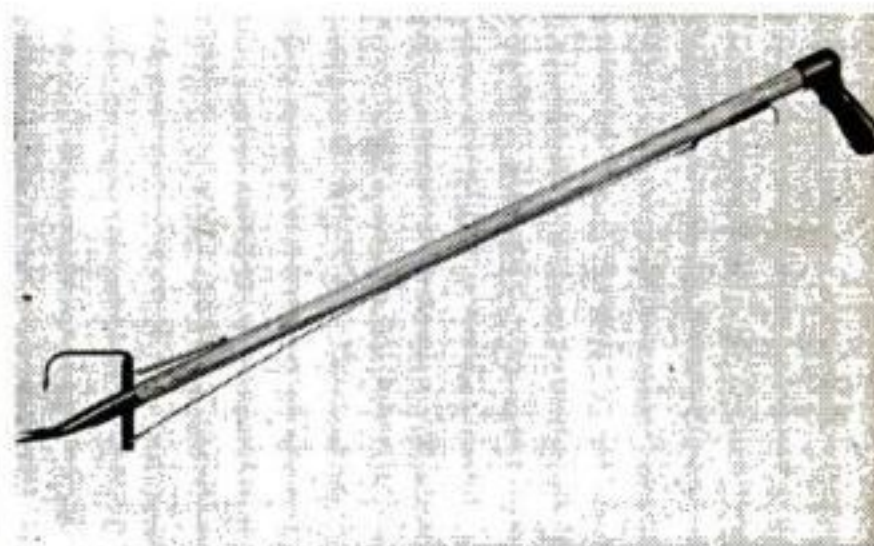
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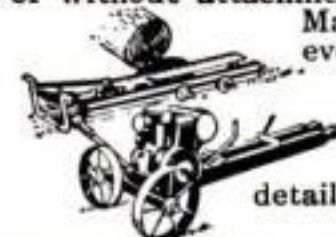
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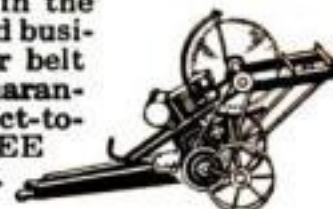


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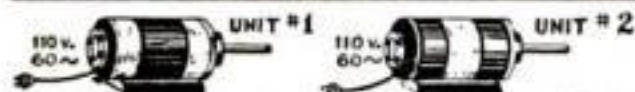
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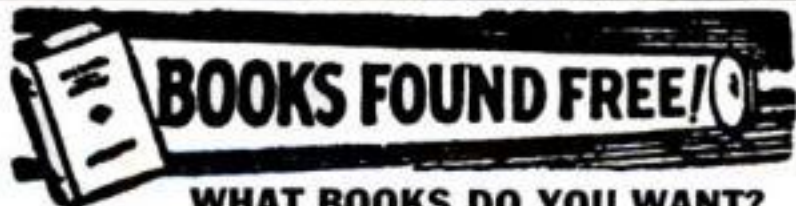
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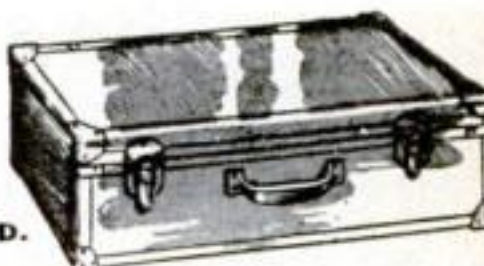
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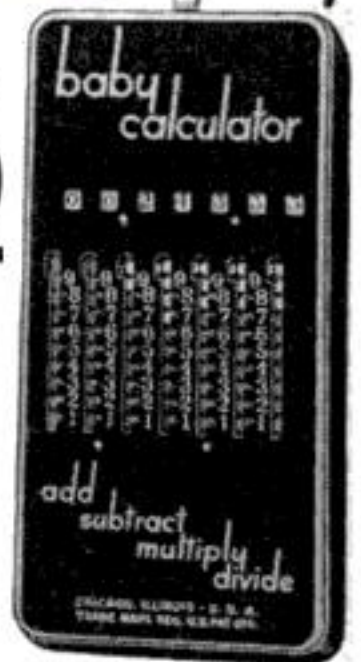
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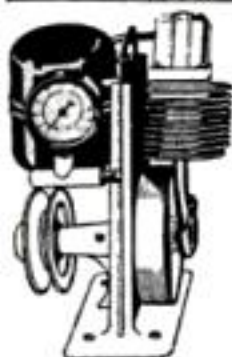
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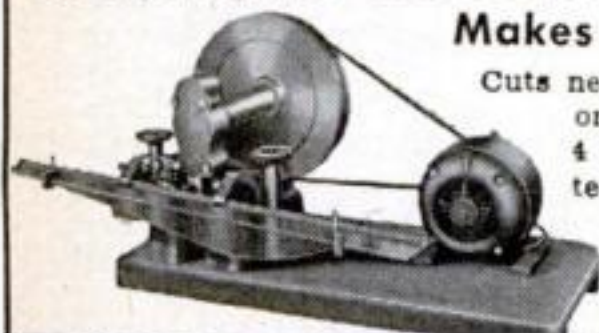
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DEC. 293
1946

TO:

FROM:

Reader
Editor

What Do a Physicist and a Mechanic Have in Common?

IT TAKES all kinds of men to make a million readers. One of *Popular Science Monthly's* best friends and keenest critics is an astrophysicist—star-snooper to you and me. He started to read PSM for relaxation, soon discovered he was getting painless information in fields of science other than his own specialty.

Another regular reader I happen to know personally is one of the smartest mechs who ever cocked an ear at an ailing motor and went right to the valve seat of the trouble. He goes for "Gus" first thing. I asked him why. He said, "It's like a puzzle—I try to solve it before Gus does. Sometimes I do; sometimes I pick up some dope I didn't know; and I'm still hoping to catch that guy off base."

Significantly, the scientist who starts PSM from the front betrays a conversational famili-



ROBERT PRESLEY STEVENSON got an early start toward PSM when, at 14, he sold an article about a bird-nesting box to a farm magazine. After graduating from Penn State, he worked for the Associated Press for

seven years. He found life exciting as a New York rewrite man but it left him little energy to enjoy a workbench or darkroom. So he eventually came to PSM, where he can think about the things he enjoys. Once an artist insisted that a gadget wouldn't work if made as shown. Stevenson came in the next morning with the gadget, built as specified. It worked.

arity with the new tools and smart gadgets. And the expert mechanic seems to know what is going on in electronics and chemistry. Which shows that one man's end is another's beginning so far as PSM is concerned.

To me, it is quite understandable that so



ROBERT GORMAN, during his last year at New York's City College, tried to promote the price of a Grand European Tour by ghostwriting. In a few years he earned for others enough degrees to stock a university and anonymously authored half a dozen books. Then side ventures left him with one pair of pants and a resolution to stick to writing. He did, until Uncle Sam gave him another pair of pants—olive drab. He returned to civilian life as editor of an encyclopedia and then came to PSM. The Army taught him where electrons go when they leave home, and this lore filters into PSM. He is also expert with saw and hammer, as some slick modern furniture in his apartment testifies.

many hard-handed characters, who didn't finish school, end up grinding their own telescope lenses and studying trigonometry; that so many professional scholars turn out handy with a hammer. For the Ph.D. and the Joe D. have a lot in common.

Both have a deep appreciation of good workmanship, an affection for materials, a



MARTIN MANN had an enthusiasm for photography that led him to specialize in optics at MIT, but didn't overshadow an early interest in journalism. The ink was hardly dry on his physics degree when Pearl Harbor took him away from his first civilian job, designing artillery fuses, and put him into uniform. He spent most of the war writing and helping produce training films in the Army Air Forces, which incidentally gave him an inside look at Hollywood. He left the Army a captain and joined PSM shortly after.

respect for tools. Hal Borland, in this issue, brings them together at the workbench; PSM, in every issue, brings them together in their minds. For what really links these two kinds of men so different in occupation and so alike in taste is a fundamental curiosity about things—what makes them tick, how they are made, how they might be adapted to some other problem.

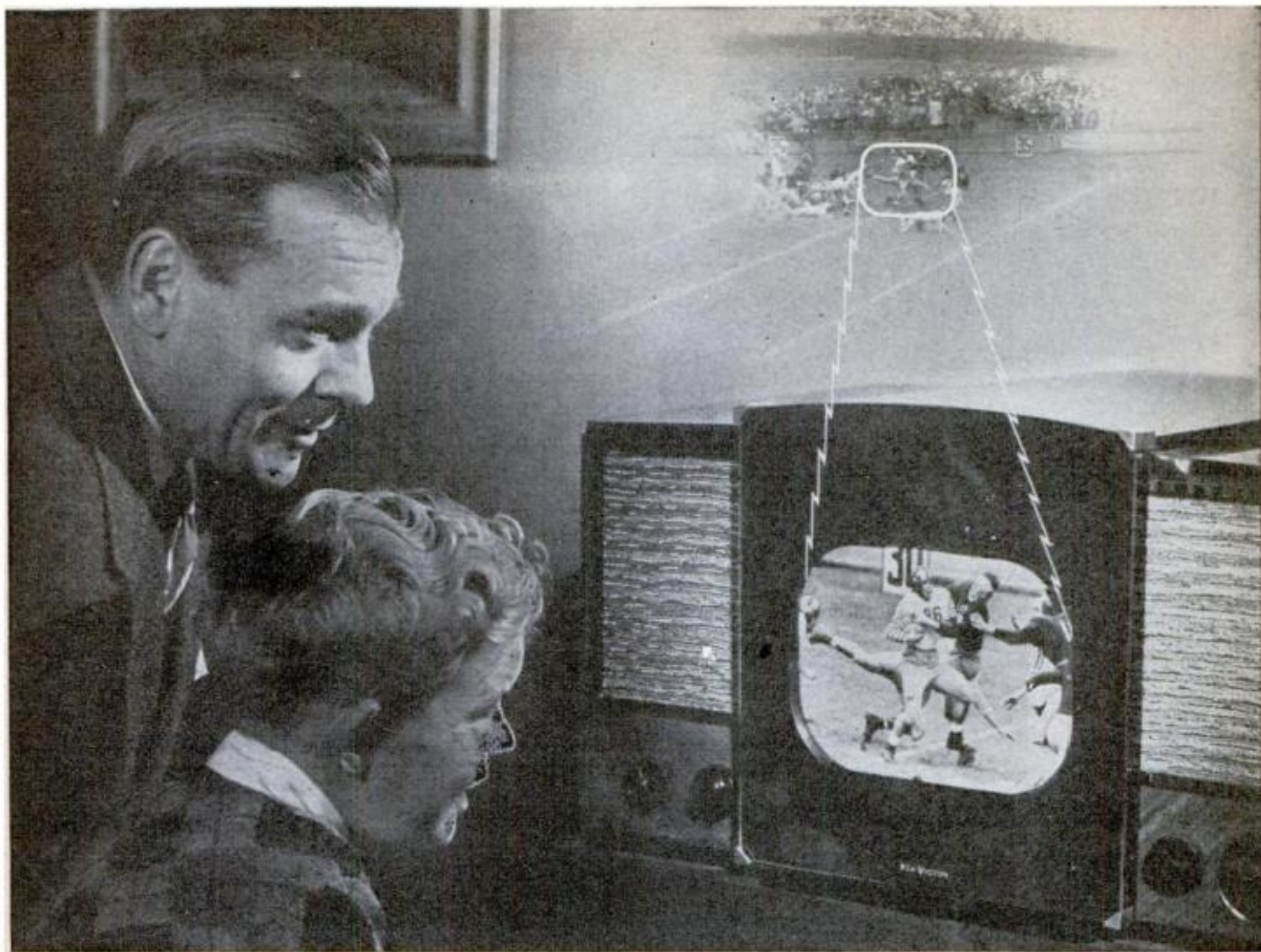
In fact, I like to think of PSM as a handbook for scientists who use their hands, and mechanics who use their heads. I don't care which end of the train they get on. They are going to the same place.



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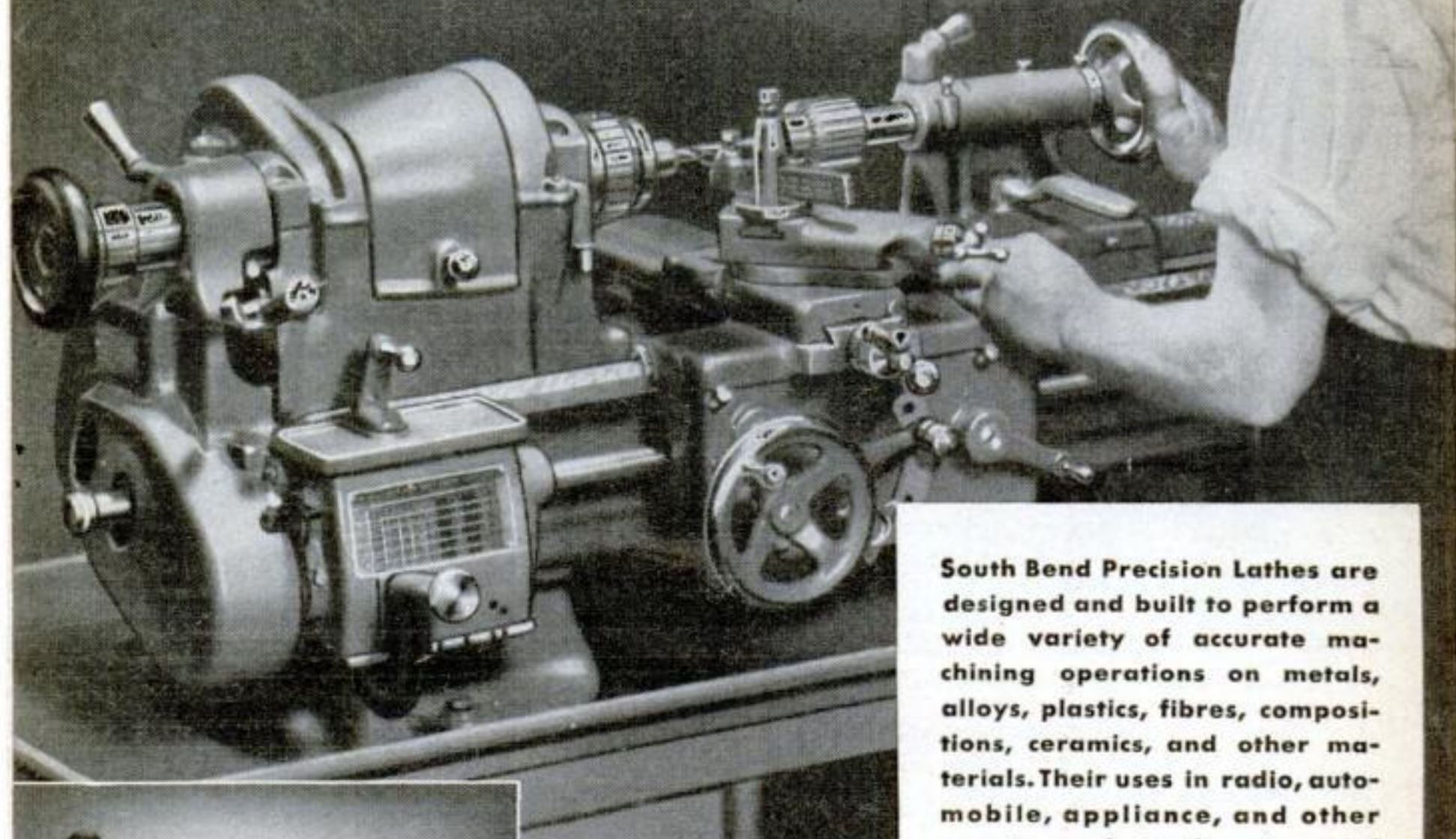
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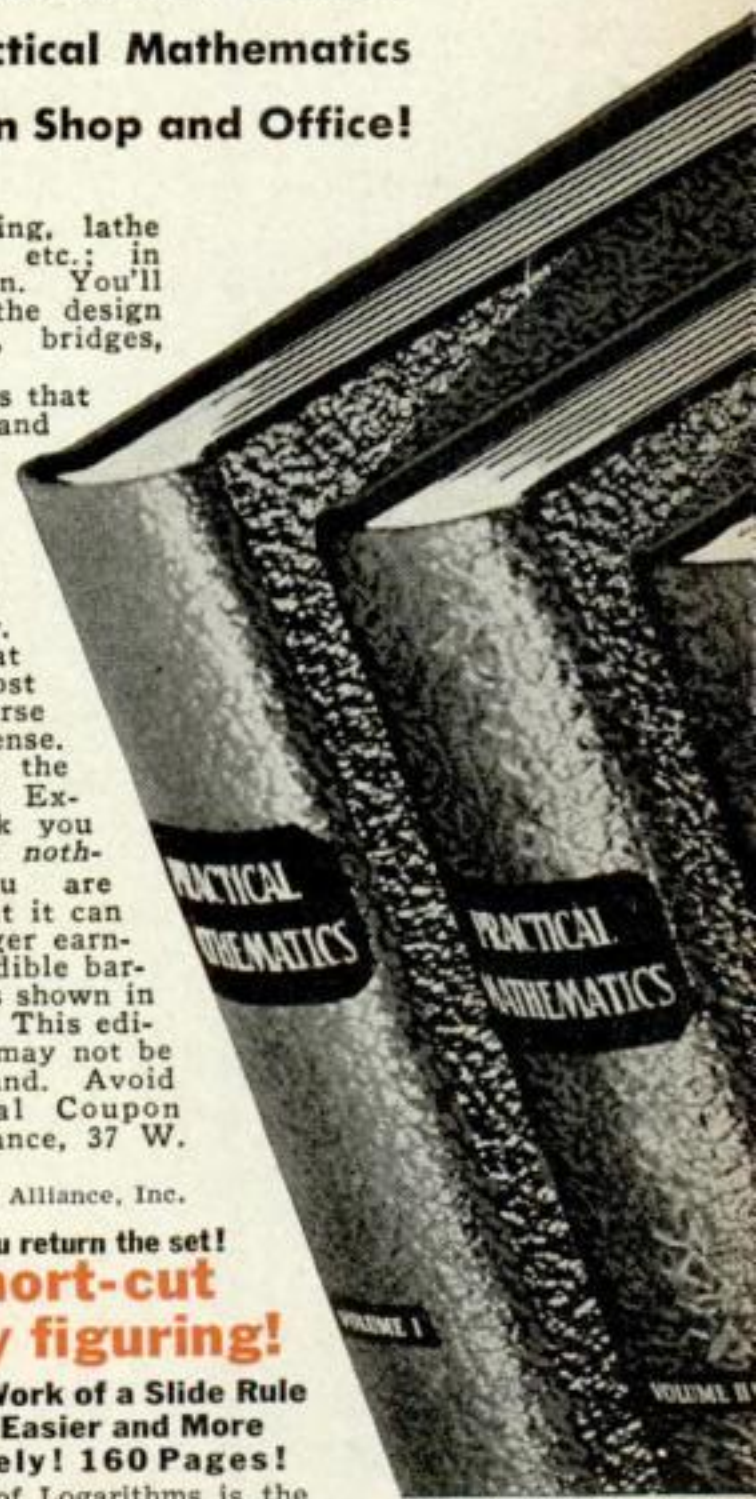
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